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Smart Air Quality Monitoring System

Shivam Bhattad¹, Rushikesh Deshpande², Srigandhrav Gaikwad³

^{1,2,3}Electronics & Telecommunication Department, PICT College; Pune University

Abstract: *The idea proposed in this project is depends on the current situation which all are facing and surviving our single day in a hope that all things will come to end very soon. All are saying that the pandemic is the only reason for all the disasters but that's not the case there are n numbers of such reasons and one of them is Air pollution. All can easily see how the environment qualities are depleting day by day but we ignore the situations and just let them on their condition, but unless we step by ourselves into it and try to push it all the way possible that situations can't be get good for us. Air is the important factor in the living things daily life but the quality now a days is so worse that many of us have some ill effects and side effects of the environment. To control and maintain the quality of air many agencies in India are working on it and try to find the easy solutions that can be adapted by the society easily. So in the honour of all such agencies we decided to put some efforts and our time to find the solution and try to have something from our side that can help mankind in such bizarre situation. Air quality monitoring is the important and yet to be fully discovered topic in this area, and also trying to implement the following project that may help to tract down and list down some measures that can be taken in future for better quality air.*

Keywords: *Classification, Arduino, Flutter, Predictive analysis, AQI Index.*

I. INTRODUCTION

India is becoming the one of the top rank holder countries in the list of a greater number of SMART-CITY. In this era every Indian is taking efforts from low to high and making their own life smart enough but in this race of smartness the major negative points that can affect the whole country and its human being is pollution. Direct emission of gases from the vehicles are mixing up with the air making air unhygienic not only the vehicles but the industrial chain the garbage chain these are also a big contributor to this dangerous pollution. The pandemic which the whole world is facing now has made the immune system of the human's somewhat poor so we are all deciding to have fresh walks and exercises but a big question is whether the air outside is fresh enough? and answer we all know. Death ratio is increasing and all we say is just one word pandemic but hold on and think is pollution also performing some role in this? As per the survey held by YouGov back in 2018 reveals the harmful effects over the human bodies, pollution can cause lung irritation, respiratory infection and even a heart attack. According to the same survey it showed Delhi Mumbai and Kolkata are the highly polluted cities. People who are living in these cities more than 70% think the air quality is harmful. Taking a serious note of all these impacts and requests the government launches many projects to survive from this situation one of them is the Delhi NCR project of Central Control Room for Air Quality Management. In such ideas authorities are providing information regarding control or minimizing the pollution or quality check to the agencies which are working under this organization. This makes the information percentage quality check transparent to the public and they can decide what to do and what not. Based on this idea we are also planning to build a software hardware integrated circuit that can sense the pollutants and send the quick alerts to the authorities so the can take quick actions and public can also use the facility and get to know the situation of their own area their place of living it is safe to be here or not? We are trying to make the system as simple as possible to install in any area and easy to handle.

II. SIGNIFICANCE OF THE SYSTEM

In the 21st century all the Govt. agencies which are well known for their work in environment and pollution control fields developed many such models. Some of them had passed all the parameters, some not, i.e. we have the back support of all these agencies' past performances, but a bigger challenge for us is the more number of people turning towards electric vehicles. In this type of automobiles, we don't have much information about glasses, their relevant sensors and behaviours so we need to track them all from scratch. An important phase pandemic impacted the whole situation and many more air factors are leading their ways up to mankind, this also be the challenges for us to track it down.

But great work comes from small investments. Stick to these words: we are planning and targeting small pieces of work and then implementing them along with the improvisation tac-tics.

III. LITERATURE SURVEY

There are approximately a 1/2 of billion motors on the street nowadays and they all are powered with the aid of using gas and diesel engines that burn petroleum to launch energy. Petroleum is made up of hydrocarbons (huge molecules constructed from hydrogen and carbon) and burning them completely with sufficient oxygen produces not anything worse than carbon dioxide and water. In practice, fuels are now no longer natural hydrocarbons and engines do now no longer burn them cleanly. As a result, exhausts from engines comprise all styles of pollutants, carbon monoxide (CO) (toxic gas), nitrogen oxides (NOx), unstable natural compounds (VOCs), and Lead (Pb) and in a roundabout way produced ozone. Mixing up those noxious gases collectively and energizing it with daylight produces once in a while brownish, once in a while a bluish fog of pollutants known as smog, that could have an effect on the towns for lots days[1]. Air Pollution offers air not worthy for respiratory with the aid of using humans & animals. Air pollutants problem has been irritated with the aid of using the high-quality growth withinside the range of motor motors in city areas. The modern day to be had 23 statistics on air exceptional have caused WHO to name for more attention of fitness dangers resulting from air pollutants and near tracking of the scenario in towns worldwide. In April 2014, WHO issued new statistics after estimating that outside air pollutants was liable for the deaths of approximately 3.7 million human beings beneath neath the age of 60 in 2012 (TNI 2014)[2].

IV. METHODOLOGY

A. Technical Specification

Major air pollution from vehicles is emitted directly into the atmosphere, and pollution from chemical industry release toxic gases into the air. There is a need to monitor, analyze the air quality and providing useful information about the atmosphere to the humans. The air quality is analyzed at different place and thereby promoting awareness in the lives of general public. The device has the capability to detect the quality of air in the surroundings and thus institutes awareness among the people. This device works on concept of IoT(Internet of Things). Our proposed layout is to become aware of the emission ranges of pollutants in city areas and commercial areas. This gadget pursuits to screen and stumble on the attention of CO2 and other gases in air in a real-time foundation and offer normal air first-rate indicators in a well timed manner. It proposes real-time implementation of pollutant ranges checking out in air and additionally detecting polluted air via way of means of the use of air first-rate Sensor and different sensor statistics is analyzed and furnished to the user via way of means of the use of idea of IoT(Internet of things).

B. Resources Required

- 1) *Microcontroller*: NodeMCU is an open-source Lua based firmware and **development board** specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module [12]

| | |
|-------------------|-----------------|
| Microcontroller | NodeMCU ESP8266 |
| Operating Voltage | 3.3V |
| Input Voltage | 7-12V |
| Digital I/O Pins | 16 pins |
| Analog Input Pins | 1 |
| SRAM | 64 KB |
| Flash Memory | 4 MB |
| Clock Speed | 80 MHz |

- 2) *Air Quality Sensor*

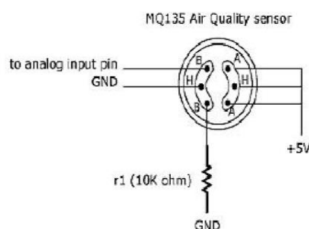


Fig 1

| SI. No | Parameter Name | Technical Parameter |
|--------|-------------------------------|---|
| 1. | Sensing Resistance (Rs) | 30kΩ-200Ω |
| 2. | Preheat Time | Over 24 hours |
| 3. | Standard Detecting Condition | Vcc: 5V ± 0.1 Temp: 20 ± 2 Humidity: 65% ± 5% |
| 4. | Concentration Slope Rate | ≤ 0.65 |
| 5. | Detection Concentration Slope | 10 ppm-300ppm NH 10ppm-1000ppm Benzene 10ppm-300ppm Alcohol |

Table 1

3) *Software Design:* Arduino Board reads inputs such as Air quality, temperature and CO2 sensor. Real-time monitoring data will be updated into web server. To do so the user can use the programming language(based on Wiring), and the Arduino Software(IDE).

C. Block Diagram

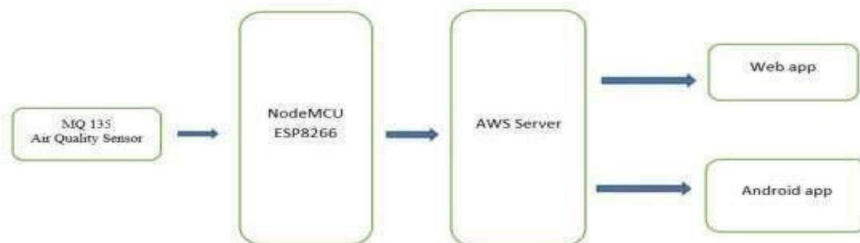


Fig 2

D. Flow Chart

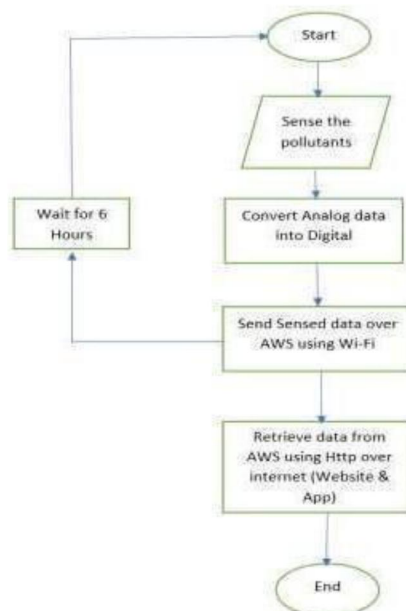


Fig 3

E. System Design

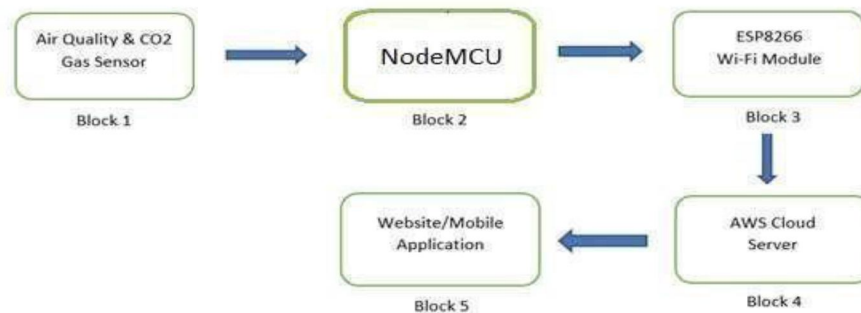


Fig 4

V. EXPERIMENTAL RESULTS

The final phase of the project was understanding the outcomes, logic for the output numbers like AQI and timestamp. As per theoretical methodology and steps, practical approach provides the near about values. System should tabulate the AQI values along with all other parameters, this aim is achieved here as website showed the air parameters with respect to city, area that user searched. Also, that outcome result was used by the tableau for visualization and it provided a perfect working dashboard. Now anyone with this website can easily analyze and observe the air quality parameters and will get to know about the new steps that government is taking to lower the pollution rate. Here in the final phase, we are getting in total 4 different outcomes that are as follows

- 1) AQI with timestamp
- 2) Visualization
- 3) Triggering emails
- 4) DynamoDB data to csv conversion

Talking about the database government is more towards the SQLite DB and SQL database in 2015 and 2016 now they are shifting their whole project over the cloud by setting different pipelines and GitHub, but here base of the project itself is the AWS cloud. Serverless architecture form is used in this project that is driven by lambda and API Gateway, strong services offered by the AWS.[7] So, we can conclude that the above project has the potential to overcome the established project in this field just the developers and management team have to work hard to solve every query till that all other projects are superior to this project and they all will contribute to building a new and upgraded version of this project. The government of India already started the NAMP National Air Quality Monitoring Programme in the year 1984 with 7 stations, from that moment government made a lot of changes to this control board and in the early '20s, they launch the site “**cpcbcr.com**” which shows the daily hourly air quality parameter now today this site has almost many numbers of user developers and big management team. Now in this project, we developed primary monitoring with a preliminary hardware and software units, but the technologies which are in use are modern in work and easy to understand.

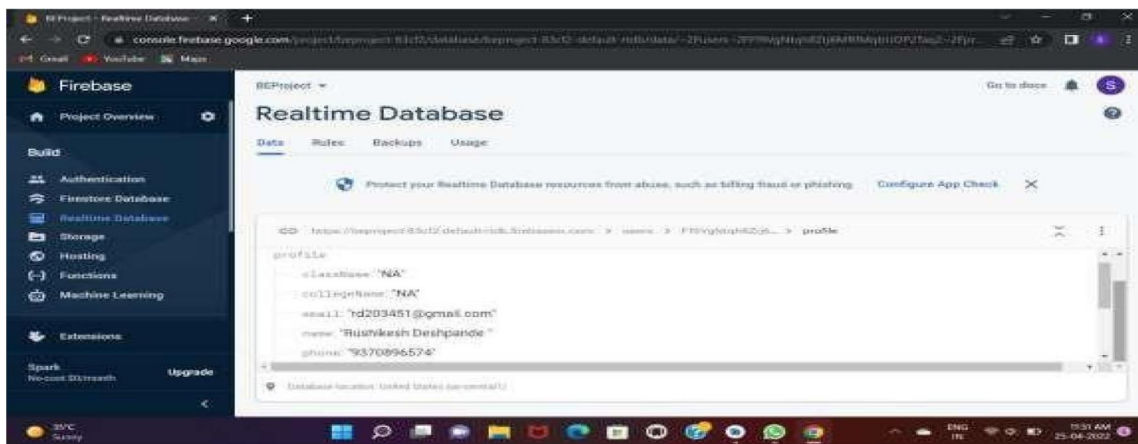


Fig 5

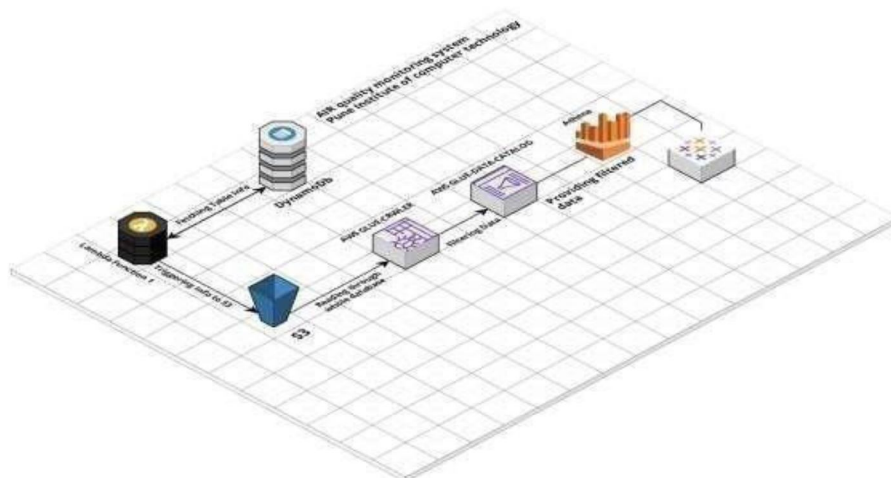


Fig 6

VI. CONCLUSION AND FUTURE WORK

This work presents a system design to understand the pollution accumulation levels at various sub-regions of the city and helps structure the readings with help of real-time analytics. Moreover, it can help city municipal cooperation to look over the small region and can take actions so that overall city is pollution-free, or we can say, maintaining the AQI index. Besides, the proposed system has come across as a cost-effective solution compared to other air monitoring devices and technologies with its most stark functionality being a combination of the Internet of Things and Amazon Web Services, proposed model can give up to 60% to 70% accuracy according to used sensors, as sensors are not much sensitive to the outer atmosphere. Accuracy can be increased to 90% after replacing the sensors with high sensitivity. The proposed model is serverless there is no requirement to see the data, which is being stored or displayed, hence it stands unique compared to other models present in the market. Therefore, real-life implementation of this proposed prototype will work as desired and benefit many people to help create a healthier society. Hence it is a smart step in the direction toward creating a SMART POLLUTION FREE CITY. GREEN CITY CLEAN CITY.

Air quality monitoring using the proposed idea has many pros and it will become a global project when it achieves all the technological and practical soundness. At this moment the project is estimating the AQI and transferring the data to the available database for the filtration. This primary milestone contains serverless database triggering circuits and integration domains, but this will still lag in the prediction of different parameters in upcoming days or giving intuitions to the user that how will be the weather in next following days. In the future, this will be easily tackled by a machine learning prediction algorithm that can process the data, understand the model data and provide the processed data that can predict up to 70 75% accuracy. The above mentioned are all the future scope implementation for the software part, but in hardware also on the primary scale, there are only assembled sensors and the controllers that are working as expected. Now this assembled hardware should be manufactured properly so the prototype will be handy and attractive also in the future working load will be increased for the reinstallation of powerful sensors and controllers will be the need. These are the future scopes that will make this project a good step towards the clean and safe air future.

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