AIRZON

Ananthu G[1]., Devika S Krishnan[2], Sruthi J[3]., Sreeraj R S[4]., Navitha K Krishnan[5], Anju V Gopal[6]
Assistant Professor[5,6]
Department of Electronics and Communication
College of Engineering, Perumon Kollam, Kerala, India

Abstract:- The air quality of a given area can be utilized as one of the key determinants of the pollution index, as well as how well the city's industry and population are controlled. With the rise of industrialisation, monitoring urban air quality has become a persistent issue. All around the world, air pollution has remained a severe concern for the public and the government. Air pollution has a notable impact on both the environment and human health, resulting in acid rain, global warming, heart disease, and skin cancer. A metric called AQI is calculated by evaluating the concentration of various PM, such as PM2.5 and PM10, present in the air to estimate the severity of air pollution. Our goal for this project is to design and construct a real-time AQI monitoring system that can be easily controlled and manufactured at a low cost, as well as an air purifier that continuously removes tiny particles (PM2.5 and PM10) from the air, decreasing the harmful impacts of pollution.

***Keywords:-** AQI ; PM ; Gases ; Air quality ; Detection ; Air purification.*

I. INTRODUCTION

Because of the negative effects of poor air quality on human health, it is now required to properly and timely anticipate the air quality index (AQI).Air pollution has reached dangerous levels as a result of increased mobility, rising global heat, and abrupt climate shifts. Fine particles or particulate matter (PM) with a diameter of 2.5 micrometers or less are the main culprits (PM2.5).A metric known as the air quality index (AQI) is determined by evaluating the quantity of various PM, such as PM2.5 and PM10, present in the air to estimate the severity of air pollution.

II. PROBLEM STATEMENT

Because of its rapid population increase, India is among the world's most polluted countries, with many cities experiencing severe environmental impacts. Many scholars have recently become interested in air pollution monitoring, determining the hazardous zone, and forecasting future air quality. There is currently no simple and low-cost technology that measures air quality. Our goal is to create a device that will monitor particulate matter levels in the surrounding air, display these levels in a straightforward manner, log the data it collects, and allow for data transfer for further research.

III. AIR QUALITY INDEX

It is a numeric system that the environmental protection agency uses to monitor air pollution .

IV. AQI LIMIT VALUES

0-50	51-100	101-150	151-200	201-300	301-500
1	2	3	4	5	6

Table 1

V. OBJECTIVES

The principal sources of air pollution are gaseous pollutants such as SO2, NOx, CO2, and particulate matter (PM) with a diameter of 2.5 micrometers or less (PM2.5) scattered throughout the air. India's industries are one of the most significant polluters. The project's main goal is to design and create a real-time AQI monitoring equipment that can be operated efficiently and built at a minimal cost. We also intend to incorporate an air purifier that removes fine particles (PM2.5 and PM10) from the air on a continuous basis, thereby lowering the negative impacts of air pollution.

VI. METHODOLOGY

The following design prototype will measure particulate matter levels in the air, display them clearly, and filter the air that travels through the circuit. The air intake gathers ambient air, which is then passed via a gas sensor and a PM sensor (major pollutant) to determine the amount of pollutants in the air. The air is passed through PM 2.5 and PM 10 filters (Electrostatic Precipitator/ HEPA), and the filtered air is passed via gas and PM sensors to determine the amount of pollutants. The microcontroller is in charge of the entire system, gathering and analyzing data from sensors. An LCD display shows the equivalent readings before and after filtration. LEDs are also available to display the rate of pollution, with the LED blinking in response to particle concentration. The filtered air is returned to the environment via the air outlet.

VII. EXISTING SYSTEM

A. Origin and Concepts of Air Quality Index

Along with land and water, air is the most vital resource for sustaining life. As technology advances, an enormous amount of data on ambient air quality is generated and used to assess the quality of the air in various regions. The vast monitoring data generates encyclopaedic volumes of data, but neither a decision maker nor the typical person who just wants to know how good or bad the air is with a simple answer can make sense of it? One technique to describe air quality is to provide the concentrations of all contaminants at their allowable thresholds (standards). Such claims about air quality frequently cause confusion, even among the scientific and technical community, when pollutant characteristics and the number of measuring sites are taken into account.

For the most part, the general population will not be satisfied with complex conclusions about air quality, such as statistical studies, time series charts, and raw data. As a result, individuals frequently lose interest and are unable to comprehend the current state of the air quality or the regulatory authorities' attempts to reduce pollution. Effective air quality communication should be implemented because people who suffer from illnesses brought on by exposure to air pollution You have to be aware of daily levels of urban air pollution. Additionally, a country's ability to improve air quality depends on the support of its populace, which must be aware of the issues with local and global air pollution and the status of mitigation measures.

Since the 1980s, many developed nations have successfully embraced the idea of an air quality index (AQI) to solve the aforementioned issues (USEPA, 1976, 2014; Ontario, 2013; Shenfeld, 1970). An AQI is a general methodology that sums up or aggregates weighted values of different air pollution-related indices (SO2, CO, visibility, etc.). There haven't been many efforts to develop and use AQI in India because a modest air quality monitoring programme was just started in 1984 and there was basically no public awareness of air pollution. It is challenging to convey complex scientific and medical information to the general public in a way that they can understand. This challenge is compounded by the need to discuss about the past, present, and future with the general public. It is essential to address these issues and afterwards construct an efficient and clear AQI scale in order for citizens and policymakers to make decisions to prevent and minimise exposure to air pollution and the diseases caused by exposure.

B. *Current Model*

According to Borghi et al., the typical air monitoring system has substantial issues with highly advanced hardware innovation, unsafe operation, high cost, and cumbersome devices. Furthermore, advanced statistical techniques supported by tools like sensors, filters, humidity monitors, and temperature monitors are required for the equipment to give accurate precision and performance. These techniques, however, consume an enormous amount of energy from the large and expensive machinery.

As a result, they are not sustainable or energy-efficient. The technology is ineffective for distant monitoring and is unable to identify an increase in pollutant concentration due to the use of conventional procedures. The greatest option for monitoring the ambient air is, ideally, a sensor that is effective, affordable, and of a reasonable size. Due to the fact that these devices are used in industry but also partially in environmental monitoring, the inability to accurately measure large amounts of certain gas contaminants in environmental situations is a problem. Thus, low- standard monitoring tools will need to be used to compare the cost sensors efficiency. To date, thorough and widely disseminated estimates of productivity are typically rare, especially for diagnostic advances that are currently employed. The goal of the project is to create a portable, high-precision, low-cost air pollution monitoring device that can measure the concentration of several types of particulate matter pollutants in the air in real time.

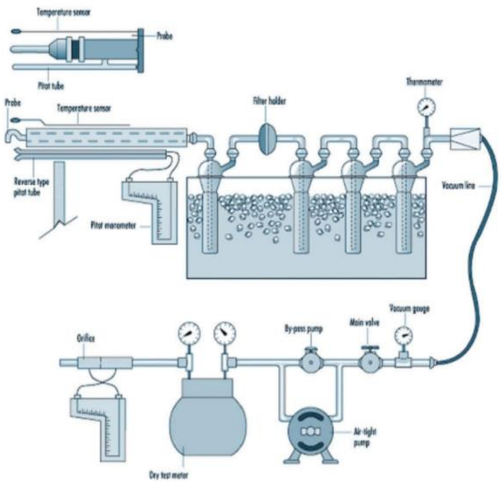

Fig. 1: Traditional air quality monitoring device

C. *Applications of Air Quality Index*

Ott (1978) has listed the following six objectives that are served by an AQI:

- Resource Allocation: To help managers choose priorities and allocate budgets. This will make it possible to evaluate the trade-offs associated with alternative air pollution control methods.
- Ranking of Locations: To aid in evaluating the air quality in various places/cities. highlighting potential dangers' locations and frequencies in the process.
- Enforcement of Standards: To ascertain the degree to which the legal requirements and accepted standards are being followed. Additionally aids in discovering flawed standards and weak monitoring initiatives.
- Trend Analysis: To assess the degradation or improvement in air quality that has happened during a predetermined period. This makes it possible to forecast air quality (i.e., track the behavior of pollutants in the air) and schedule pollution control procedures.
- Public Information: To educate the public on environmental issues (state of environment). People with illnesses worsened or brought on by air pollution can benefit from it. When people are aware of excessive pollution levels, it helps them to change their everyday routines.
- Scientific Research: while conducting a study of some environmental events, as a way of condensing a big quantity of data into a comprehensible form that provides the researcher with more insight. This enables a more objective assessment of the contributions of particular contaminants and sources to the level of overall air quality. Such techniques are more useful when combined with additional sources, including local emission surveys.
- The general public can use an AQI to understand air quality in a straightforward manner, politicians can act quickly, decision-makers can map out corrective pollution control strategies by understanding the trend of events, government officials can examine the effects of regulatory actions, and scientists can use air quality data in their research.

D. Broad Guidelines for Actions during Very Poor and Severe Categories of AQI

a) Regulating Agencies
In order to determine how emissions affect air quality, the regulatory agencies need develop source-receptor interactions. The appropriate actions must be done by further restricting the emissions that are having the greatest influence on ambient air quality in the event that the AQI category is severe or very poor. Examples of specific measures could be I strict vigilance and a zero-tolerance policy toward visible polluters like construction sites, industries, open burning, and vehicles; (ii) traffic regulation; and (iii) identifying the sources most responsible for the deteriorating air quality and taking steps to reduce their emissions.

b) Public
People should keep their cars maintained properly (such as by getting PUC inspections, replacing the air filter, and maintaining the proper tyre pressure), observe lane rules and speed limits, prevent prolonged idling, and turn off the engine at red traffic lights. Additionally, people should limit travel during periods of severe or extremely poor AQI, avoid driving private automobiles in favour of public transportation, bicycles or walking, and carpooling, and use smaller vehicles (e.g. avoid SUVs). Diesel generator usage ought to be kept to a minimum. People may think about avoiding unwarranted exposures, particularly those who have asthma or cardiac condition.

VIII. RELATED WORKS

This work describes the creation of an air quality monitoring system (AQMS) that can measure the air quality in both indoor and outdoor settings and, upon detection of a hazardous air quality index (AQI) level, can notify the user via an alarm system. The system measures the area's temperature, humidity, and level of hazard gases utilising the Arduino platform, numerous sensors, a flat-panel LCD, and Bluetooth modules. The AQMS is a portable air quality index (AQI) acquisition tool that displays real-time measurements on the LCD and is lightweight and portable. It is an easy-to-use tool that is convenient to utilise. The AQMS allows the general population the chance to check the air quality for themselves, which raises awareness of the air quality in the area and works to improve it. [1]

The goal of this study is to use the Extreme Learning Machines (ELM) algorithm to forecast the air quality index (AQI). Six variables that can impact the AQI have been chosen for this reason. These are, respectively, the temperature, humidity, pressure, wind speed, PM10, and SO2. The relationship status between these six parameters was first established using the "Forecast Sheet" program, which was shown in the Excel environment, and correlation analysis. The "AQI Calculator" application was then used to obtain the AQI values for these six parameters. The National Air Quality Monitoring Network of the Ministry of Environment and Urbanization established AQI standards, and these limitations were used to numerically classify the derived AQI values from 1 to 6. [2]

In order to evaluate the status of air pollutants (TSPM, RPM, SO2, NO2, and Free Cl2) and the air quality of the industrial zone and its surroundings, which are also residential areas, a thorough study was carried out in the Chavara industrial area's surroundings in the Kollam district of South India during the summer and winter seasons of 2011. According to the study's findings, SO2 and NOx concentrations fell under the national ambient air quality standard limits set by India's Central Pollution Control Board and Ministry of Environment & Forests. The industrial area's study sites in the north, east, and south recorded chlorine contamination.

Residents may experience a variety of health issues, particularly youngsters and the elderly, as a result of the presence of PM10 and chlorine in the residential area close to the KMML industrial zone. The residential neighbourhoods near the KMML industrial sector have moderate air quality, according to an assessment of the survey stations' air quality index. Additionally, some actions are recommended to raise the air quality around the KMML industrial region.[3]

In this work, we look into a multi-source machine learning approach to approximating the neighbourhood AQI scores at users' locations in a huge city. Three main data sets, "SEPHLA-medieval 2019," "MNR-Air-HCM," and "MNR-HCM," obtained in Ho Chi Minh City (Vietnam) and Fukuoka City, are the subject of several studies that we run (Japan). We extract a variety of useful attributes for the problem from the provided data sets, including timestamp information, geographic data, sensor data (temperature and humidity), user-tagged emotion tags (such as calmness, greenness, etc.), semantic features from user-captured images, and open weather data (including temperature, dew point, humidity, wind speed, and pressure) for the related cities.Then, we examine Support Vector Machine [1], Random Forest [2], Extreme Gradient Boosting [3], LightGBM [4], and CatBoost [5] as five different machine learning models for estimating the local AQI score and level .[4]

In a chamber with a clearly defined aerosol, this study evaluated the performance of nine inexpensive PM monitors (AirVisual, Alphasense, APT, Awair, Dylos, Foobot, PurpleAir, Wynd, and Xiaomi). The reference tools were the SidePak and the GRIMM. According to how they operate and how they report data, the monitors were split into two groups, and for each group, a linear correlation factor for the measurement of PM2.5 mass concentration was calculated. To further illustrate the degree of improvement possible with calibration, the variations between the mass concentrations recorded by the individual monitors and those measured by the reference equipment were plotted against their average before and after user calibration. For monitors reporting size distributions, bin-specific calibration was also carried out to highlight coincidence errors that can skew the outcomes. The tested monitors include inexpensive sensors in easy-to-use, deployment-ready kits that don't require any additional construction. However, user-defined calibration for the target PM source is still advised in order to increase measurement accuracy.[5]

ISSN No:-2456-2165

This study forecasts the Air Quality Index (AQI) based on temperature, PM2.5, PM10, SO2, wind direction, NO2, CO, and O3 data provided by the environmental protection department. This study begins by introducing the background, technical features, state of development, and issues with air environment monitoring. It will then introduce the model for predicting the environment. Finally, we use LSTM to predict the AQI and examine the accuracy of the results. The findings indicate that LSTM can accurately forecast the air quality index. [6]

The combined model's objective is to combine the positive aspects of each model and mitigate its negative aspects in order to get the best possible prediction performance. As a result, this research suggests a scientific ARIMA+PSO-LS-SVM combination model based on wavelet transform. First, the AQI time series were preprocessed using wavelet analysis. The linear autocorrelation part and the nonlinear part are then predicted using the ARIMA model and the LS-SVM model, respectively. The LS-SVM model's parameters are optimised using the PSO algorithm. Simulation trials demonstrate that the combined model does reduce errors when compared to the conventional ARIMA model and LS-SVM model and has superior accuracy. This is after choosing the suitable wavelet decomposition function and parameters of the combined model. It offers a fresh method for predicting the actual air quality index. [7]

IX. PROPOSED SYSTEM

The project is divided into 2 stages
- AIR Quality Detection
- AIR purification

a) Air quality detection
In this phase the air collected is detected using different gas sensors and pm sensors and the AQI is obtained. The AQI value are depicted below:

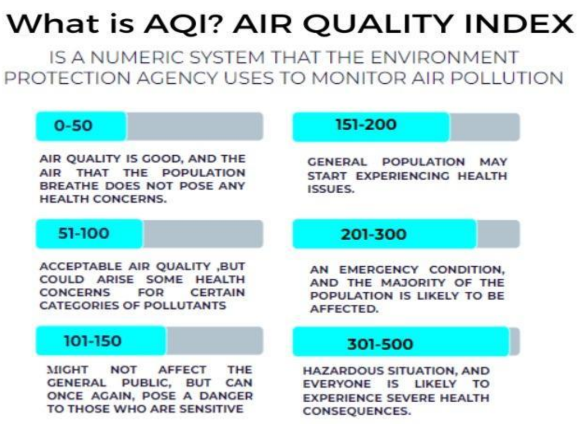

Fig. 2: AQI Values

b) Air purification
The air entering into the device is passed onto hepa filter where the pm particles and other contaminants are removed and the fresh air is released back into the atmosphere. Thus the model purifies the entire air molecules circulating throughout the system.

X. FLOW CHART

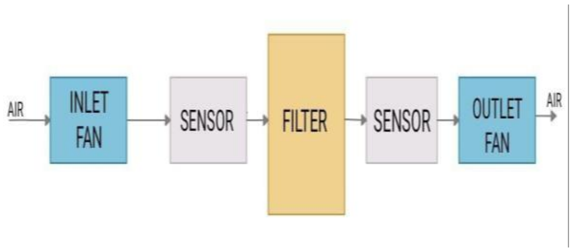

Fig. 3

XI. BLOCK DIAGRAM

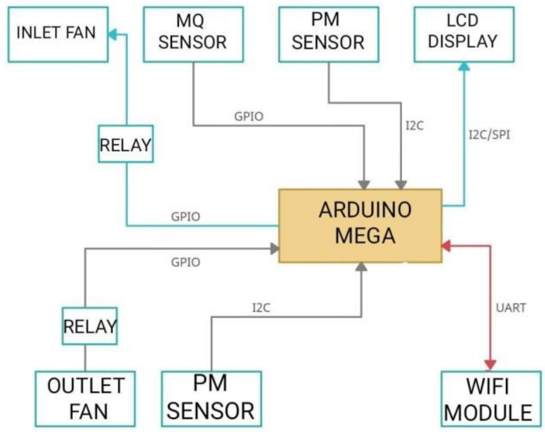

Fig. 4

XII. CIRCUIT DIAGRAM

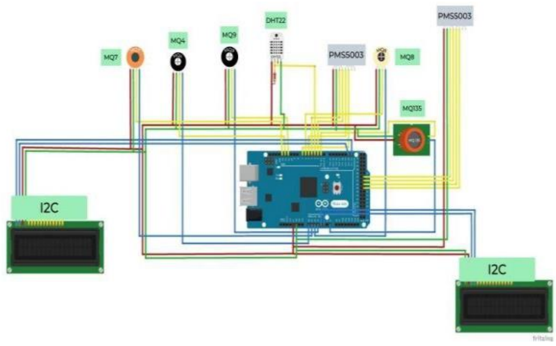

Fig. 5

XIII. EXPERIMENTAL ANALYSIS

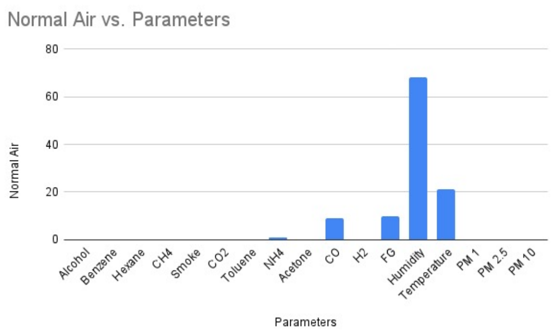

Fig. 6

ISSN No:-2456-2165

In the experimental analysis we give a comparison between normal air v/s various parameters that affect the air quality. We also give a comparison between normal air, incense stick burning, coconut husk burning v/s various parameters that affect the air quality at Decent Junction of Kollam district and comparison between normal air, air conditioned room at Ramankulangara of Kollam district.

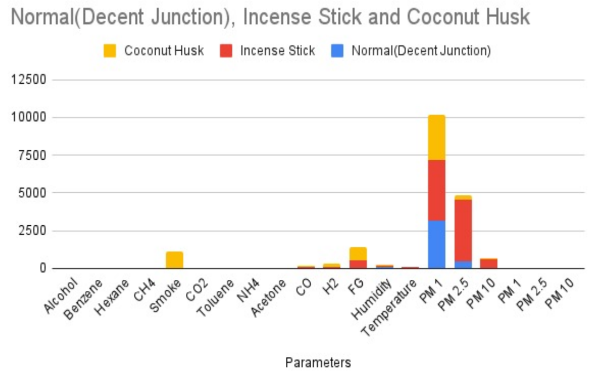

Fig. 7: NORMAL AIR, INCENSE STICK, COCONUT HUSK (DECENT JUNCTION)

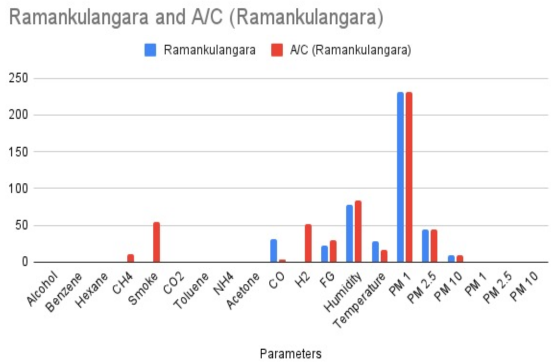

Fig. 8: NORMAL AIR, A/C ROOM (RAMANKULANGARA)

XIV. RESULTS AND DISCUSSION

To make sure the suggested system satisfies the requirements, several different tests were carried out. A multimeter was used to test each component of the system individually to verify continuity and power ratings. Prior to integration into the system, a test was conducted to confirm their functionality. This type of testing is known as unit testing. After that, sub-unit testing was put into action. Each sub-unit was tested to ensure proper operation before being incorporated into the proposed system. At this point, it was determined whether the sensors and modules were compatible with the microcontroller by testing. The components were correctly assembled in order to compute the current and voltage consumption. Additionally, the complete air monitoring system underwent system testing. At this stage, the planned system was thoroughly tested with all of the associated sub-units and parts, as depicted in the schematics. The system was powered during the testing, and it performed flawlessly. The whole system was cased airtight.

XV. CONCLUSION

Our goal for this project is to design and create a real-time AQI monitoring system. This can be easily controlled and built at a low cost, as well as an air purifier that continuously removes tiny particles (PM2.5 and PM10) from the air, decreasing the detrimental impacts of air pollution.

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