IoT BASED AIR QUALITY MONITORING SYSTEM

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Abstract: Air pollution is the largest public health challenge in the world. It leads to adverse effects on Human health, climate and ecosystem. This creates a need for measurement and analysis of real-time Air quality monitoring which can be done using different sensors. This paper presents a real-time standalone Air quality monitoring system which includes various parameters: PM2.5 and PM10, an invisible particles circulates in air which can be measured using Nova PM Sensor SDS011. PM particles are generated larger in amount while burning any material. In addition to this, we use BME280 sensor to measure Temperature, Pressure, Humidity and Altitude to monitor the changes in PM accordingly to these parameters. The sensed data are displayed in Blynk App and compared with Air Quality Index to identify the quality of air.

Index Terms— PM2.5, PM10, Air Quality Monitoring.

INTRODUCTION

Air pollution, releases various gases, finely divided solids or liquid aerosols into the atmosphere which exceeds the normal capacity of the environment. Eleven out of 12 most polluted cities in World Health Organization list are in India. Invisible fine particles in air are the major risk factor worldwide.

Particulate Matter (PM) :
They are minute particles floating in air which is made up of ash, metals, soot, diesel exhaust, and chemicals. Particles are divided into two major groups based on size, PM2.5 and PM10. The smaller particles PM2.5 are smaller than 2.5 micrometers. The coarse particles PM10 are between 2.5 and 10 micrometers.

Air Quality Index (AQI) : AQI is a tool used by government agencies to interact with the public for reporting them the quality of the air whether it is polluted or not. Table 1.1 explains the six levels of health concerns**.**

AQI Category	PM 2.5	PM10	Health category
Good(0-50)	0-30	0-50	Minimal
Satisfactory (51-100)	31-60	51-100	Minor breathing discomfort to sensitive people
Moderately polluted(101-200)	61-90	101-250	Breathing discomfort to children
Poor(201-300)	91-120	251-350	Breathing discomfort to all
Very poor(301-400)	121-250	351-430	Respiratory illness on prolonged Exposure
Severe(401-500)	250+	430+	Health impact even on light physical work

Table 1.1: Air Quality Index

2. LITERATURE SURVEY

2.1 Air Quality Monitoring System for City:

Pradeep D.Landge, R.R.Harne, International Journal of Engineering and Technology, November 2016.

This paper designs and implements a system for air quality monitoring using IoT. The model initiates from sensor devices that can sense, compute, and communicate data in a network. This system measures real-time PM2.5, temperature, humidity, Air Quality Index. Monitored data is wirelessly transmitted via Wi-Fi module to a server. When the sensor node reads pollutant gases composition, temperature and humidity it will be displayed on the website. The monitored data with date and time can be retrieved as a tabular data for future analysis. By implementing this work, precautionary alerts can be given to public on the designed website to wear anti-pollution mask, change paths of transportation when there is high air pollution ensuring high reliability. It will promote the public awareness about state of air pollution and how much important it is to reduce it. There will be data, surveys about the pollution in different countries, the different ways that are available to reduce the air pollution.

2.2 Design and Development of web based sensor for Monitoring Industrial Air Pollutants:

Santosh G. Bhandarakawathe, Prof. S. B. Somani, International Journal of Electronics, Electrical and Computational System, 2017.

This system monitors the industrial air pollutants like Temperature, Carbon Monoxide, Nitrogen Dioxide, PM2.5, PM10 and displays the parameters data on a webpage is the key port of this system.

2.3 Design and implementation of LPWA-based Air Quality Monitoring System:

Kan Zheng, Shaohang Zhao, Zhe Yang, Xiong Xiong, Wei Xiang.2016.

The existing Air Quality Monitoring systems cannot provide satisfactory resolutions of the air quality monitoring information with low costs in real time. In this system, portable sensors collect the air quality information timely, which is transferred through a low power wide area network, processed, analysed in IoT cloud and deployed in urban environments.

2.4 IoT Based Weather Station.

Ravi Kishore Kodali , Snehashish Mandal. International Conference on Control, Instrumentation, Communication and Computational Technologies, 2016.

The major part of the system is the ESP8266 based Wi-Fi module NodeMCU. Four sensors are connected to the NodeMCU namely temperature and humidity sensor (DHT11), pressure sensor (BMP180), rain drop module and light dependent resistor (LDR). Whenever the value exceeds a chosen threshold limit for each an SMS, an Email and a tweet post is published alerting the owner of the appliance to take necessary measures.

3. OBJECTIVE

Our project objective is to monitor the PM2.5 and PM10 particles floating in atmosphere using Nova PM SDS011 sensor. PM particles are generated while burning any kind of material. This system continuously monitors the PM level based on AQI guidelines and displays whether the quality level of air is Good or Critical. These are invisible particles which changes according to environmental conditions hence they are also measured using Air Temperature Humidity BME280 sensor. The collected data from both sensors are monitored in Blynk App, Iot platform.

4. PROBLEM IDENTIFIED

The World Health Organization's air quality guidelines recommend that the annual mean concentrations of PM2.5 and PM10 should not exceed as per the Table1.1. Most low and middle-income countries do not have any measurement for PM10 and PM2.5.This has increased the health risks due to exposure to these air pollutants. Eleven out of 12 cities in the list published by WHO are in India, under risk factor due to these pollutants. Hence there should be continuous monitoring of pollutants in risk areas.

5. PROBLEM SOLUTION

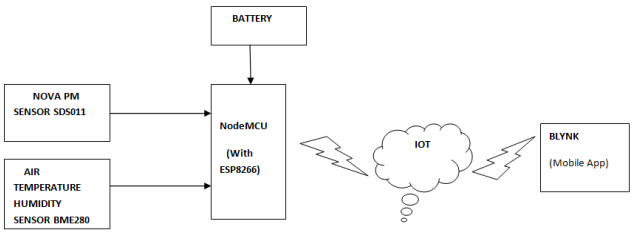
To overcome the problem in monitoring the PM level, we have developed this system to continuously monitor the Particulate Matter level in atmosphere using Nova PM Sensor SDS011 and Environmental Parameters like Temperature, Humidity, Pressure, Altitude are measured using Air Temperature Humidity BME280 Sensor.

6. PROPOSED METHODOLOGY

6.1 System Setup

This system consists of three modules:

6.1.1 SDS011 Sensor Module
6.1.2 BME280 Sensor Module
6.1.3 IoT Implementation Module



6.1.1 SDS011 Sensor Module:

We use Nova PM Sensor SDS011 to measure PM2.5 and PM10. The threshold Limit of PM2.5 and PM10 for 24 hours average is 35 $\mu g/m^3$ and 150 $\mu g/m^3$ respectively. As per the AQI table, the PM level is analysed.

Fig. 6.1.1 SDS011 Sensor

6.1.2 BME280 Sensor Module:

Air Temperature Humidity BME280 sensor is used to measure the environmental parameters like Temperature, Humidity, Altitude, Pressure. As PM level changes with environment conditions.

Fig. 6.1.2 BME280 Sensor

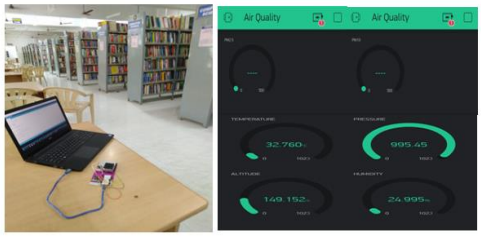
6.1.3 IoT implementation Module:

The collected data are monitored in Mobile using Blynk IoT platform. Blynk includes three components: a Blynk app for the Smartphone, the Blynk server, and Blynk library (firmware), which is compatible with hardware. Both the Blynk server and Blynk library are open source and the Blynk app is available free for iOS and Android.

7. RESULT

The system is tested in various locations. The following figures are the tested sensor outputs.

Location 1: Library

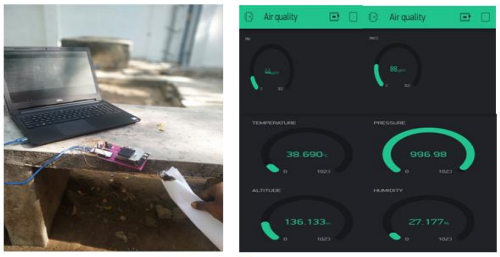


AQI is **Good**

Location 2: AC Hall

AQI is **Good**

Location 3: Flaming Paper



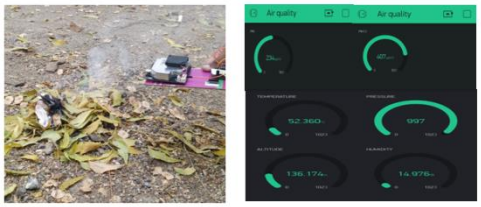
AQI is **Satisfactory**

The above figures are the tested outputs of the sensors measured at Library, AC Hall, Flaming Paper, Vehicle Emissions and Garbage burnings and displayed using Blynk App

Location 4: Vehicle Emissions

AQI is Moderately polluted

Location 5: Garbage Burnings



AQI is **Poor**

Table 7.1 explains the variations in PM level and according to the variations corresponding AQI status is mentioned.

LOCATION	PM2.5(µg/m3)	PM10(µg/m3)	AQI STATUS
Library	0-15	0-25	Good
AC Hall	15-30	25-50	Good
Flaming Paper	30 - 50	51- 100	Satisfactory
Vehicle Emissions	51-90	101-250	Moderately Polluted
Garbage Burnings	121 and above	351 and above	Very Poor

Table 7.1 Tested PM level Variations

8. CONCLUSION

Our paper aims to give solution to continuously monitor the quality of the air. Particulate matter floating in atmosphere is measured and monitored using IoT for further analysis by displaying the increase in pollution level.

9. FUTURE WORK

Several modules of this system is implemented in various places of city connected to a primary home node which is the major system. Data from Sensors are collected, stored and maintained directly at the Cloud server. The Controller collects all the data uploading from sensors and transmits it to the Cloud server by using the Wi-Fi module, which is mounted on controller. The data on the cloud server will be displayed location wise. This will be helpful in further analysis for interpretation

10. REFERENCE

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