INTERNATIONAL JOURNAL OF TECHNO-ENGINEERING
IJTE

ISSN: 2057-5688

A Raspberry Pi Controlled Cloud Based Air and Sound Pollution Monitoring System with Temperature and Humidity Sensing

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ABSTRACT *— In recent day scenarios, the incessant increase in air and sound pollution prove to be an alarming problem. It has become mandatory to control and appropriately monitor the situation so that the required steps to curb the situation can be undertaken. In this project, an IOT-based method to monitor theAir Quality Index and the Noise Intensity of a region, have been proposed.There commended technology comprises off our modules namely, the Air Quality Index Monitoring Module, theSound Intensity Detection Module, the Cloud-based Monitoring Module and the Anomaly Notification Module. Firstly, the Air Quality Index is measured considering the presence of the five criteria air pollutants. Then the sound intensity is detected using the respective sensor. After that, the Cloud-based Monitoring Module ensures the process of acquiring the data with the help of Wi-fi-module present in Raspberry Pi which fulfills the objective of analysis of information on a periodical basis.Finally,the Anomaly Notification Module alert st heuser incase of an undesired condition.*

Keywords—*Raspberry Pi 3B; MQ -135; LM 393; Air QualityIndex;Sound Intensity.*

I. INTRODUCTION

Air and sound pollution is a growing issue these days.It is necessary to monitor the air and sound pollution levels to ensure a healthy and safe environment.With the rapid increase in infrastructure and industrial plants, environmental issues have greatly influenced the need of smart monitoring systems.Due to its low cost, high efficiency and versatility, Internet ofThings(IoT) has become very popular now these days. The Internet of Things(IoT) allows interaction between devices and humans. It forms a communication medium from human to machine. Previously,data collectors had to travel long distances to the various locations to collect data after which the analysis was done. This was lengthy and time consuming. But now, sensors and microcontrollers connected to the internet can make environmental parameter monitoring more flexible,accurate and less time consuming. When The environment merges with sensors and devices to self -protect and self -monitor it forms a smart environment. Embedded intelligence makes the environment interact with the objects.In this model, We are using a Raspberry Pi 3B microcontroller, which will have gas sensors and noise sensors connected to it, to monitor the fluctuating environmental parameters.

II. RELATED WORK

First,L.Ezhilarasi Metal. Have proposed a monitoring technique using a Zigbee wireless sensor network to monitor the various environmental parameters. It uses RFID means to store and retrieve data through electromagnetic transmission toan RF integrated circuit. The WSN gateway method is used to conveniently collect the data at any time and place.[1]

Mahantesh B Dalawai et al. in their paper have used a GPRS/GSM module and a web server to coefficiently monitor the various pollution levels. In the module the smoke sensor and noise sensor will upload the data to the server or cloud ate very instant of time so that the pollution level can be monitored using the internet.[2]

Arushi Singh et al. have proposed a system which uses air and sound sensors to monitor the data constantly and then transmit the data. A raspberry pi module interacts with the sensors and processes the data thereby transmitting it to the application.[3]

Dr. Sumithra et al. have proposed the concept of a smart city. Technology and communication is the basis of this smart city. Various sensors and modules have also been used to monitor the various environmental parameters. This system uses air and sound sensors to monitor the data and then upload the data on the cloud server as digital data. The cloud storage managers analyze the data and notify

ISSN: 2057-5688

accordingly.[4]

Mohannad Ibrahimetal has proposed the design of a cost effective environmental monitoring device using Raspberry pi. The information is collected by the sensors and uploaded to the internet where it could be accessed anytime. The system was found to be accurate in terms of measuring humidity, temperature etc.[5]

Giovanni B. Fioccola et al. have proposed Pollution, an Arduino based air pollution monitoring system.

A.Raspberry Pi (ARM-11) PROCESSOR:

The Raspberry Pi can be set up to run like a standard (albeit bare bones) desktop computer, that isn't really the point. Rather, it's intended to be used as an educational tool for those who wish to learn to program. It's also intended to be modified and customized for specific tasks. In this version, they've upgraded to a 1.2 GHz 64-bit quad-core ARM processor and added 802.11n Wireless LAN, Bluetooth 4.1 and Bluetooth Low Energy. If you're searching to incorporate the Pi into your next embedded design, the 0.1" spaced 40-pin GPIO header offers you get admission to 27 GPIO, UART, I2C, SPI as nicely as each 3.3V and 5V energy sources. Raspberry Pi processor is programmed the use of embedded 'Linux'. Linux is the best-known and most-used open source running system. As an running system, Linux is software program that sits under all of the other software on a computer, receiving requests from those applications and relaying these requests to the computer's hardware.

B. Air quality sensor:

Air quality sensor for detecting a wide range of gases, including NH3, NOx, alcohol, benzene, smoke and CO2. Ideal for use in office or factory. MQ135 gas sensor has high sensitivity to Ammonia, Sulfide and Benze steam, also sensitive to smoke and other harmful gases. It is with low cost and particularly suitable for Air quality monitoring application. MQ135 Gas Sensor module for Air Quality having Digital as well as Analog output. Sensitive material of MQ135 gas sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exist, the sensors conductivity is higher along with the gas concentration rising. MQ135 gas sensor has high sensitivity to Ammonia, Sulphide and Benze steam, also sensitive to smoke and other harmful gases, tested concentration range: 10 to 1000 ppm.

C. DHT11 Temperature and HumiditySensor

DHT11 is a humidity and temperature sensor. It can be used to monitor the temperature and humidity levels in a region. It can be interfaced with a Raspberry Pi module and can give immediate results. In this project, we are using these sensor to monitor the varying humidity and temperature levels.

Fig.3.DHT11TemperatureandHumiditySensor

III. METHODOLOGY

INTERNATIONAL JOURNAL OF TECHNO-ENGINEERING
IJTE
ISSN: 2057-5688

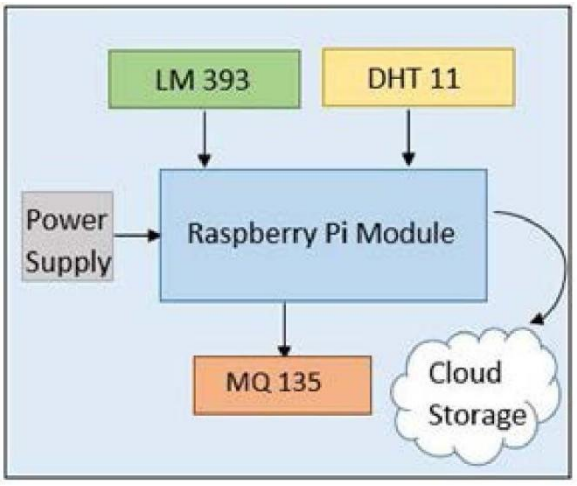


Fig.6.BlockDiagramoftheSystem

A. *AirQuality Index*

It is a value that is communicated by the government to the public as to how polluted the environment is or will become.As the AQI increases, various health hazards come up. The AQI can be computed by calculating the average pollutant concentration over a specified period. The formula for calculating AQI is,

$$I = \frac{I_{high} - I_{low}}{C_{high} - C_{low}}(C - C_{low}) + I_{low}$$

I=Air Quality Index

C=The Pollutant Concentration Low= Concentration breakpoint that is ≤ high= Concentration breakpoint that is ≥ CIlow= Index breakpoint corresponding to ClowIhigh=IndexbreakpointcorrespondingtoChigh

The air quality index and its impact on health as prescribedbythegovernmentisgivenbelowwithproper colorcode

TABLE I. AIR QUALITY INDEX,HEALTH IMPACT AND COLOR CODE

AirQualityIndex	HealthImpacts	Color
Good (0-50)	MinimalImpact	
Satisfy(51-100)	MildBreathingDistress	
ModeratelyPolluted (101-200)	Breathing Distress And Discomfort To people with heart disease	
Poor(201-300)	Breathing Discomfort To People On prolonged exposure	
Very Poor(301-400)	May Cause Respiratory Illness	
Severe(401-500)	Severe Respiratory Impact On People With lungs and heart disease	

B. *NoisePollutionLevel*

Noise pollution has the most harmful impact on human or animal life. Noise pollution generally occurs due to the sound coming from honking cars, industries, factories, heavy machinery etc. Certain noise standards are prescribed by the government that need to be maintained.

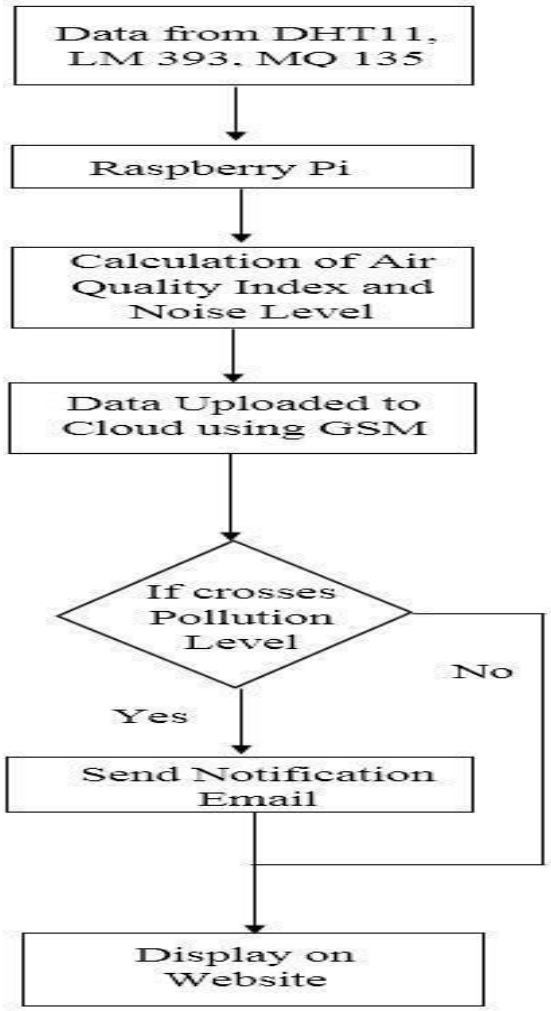
TABLE II. STANDARD NOISE LEVEL LIMIT IN DIFFERENT AREA

Code	Area	Day Time	Night Time
A	Industrial Area	75	70
B	CommercialArea	65	55
C	ResidentialArea	55	45
D	SilenceZone	50	40

ISSN: 2057-5688

The objective of our work is monitoring the air quality of a region and the detection of noise intensity to curb the problem of sound pollution. The proposed method involves cloud based monitoring of the required parameters with the help of the internet.The alert system ensures that the user is notified about any unfavorable condition which demands instantaction.

The proposed model consists of the following modules,namely, the Air Quality Index Monitoring Module, the Sound Intensity Detection Module, the Cloud-based Data Monitoring Module and finally the Anomaly Notification Module.



INTERNATIONAL JOURNAL OF TECHNO-ENGINEERING
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IV. RESULTS

This paper discusses the methodology and results of each of design for the concerned data. All methods used in this paper provides accurate results in classification with high accuracy and widely used cloud storages. Its process are done in inner network so its saves time, reduces the labour work and result is also high. This method is very useful for all consumers.

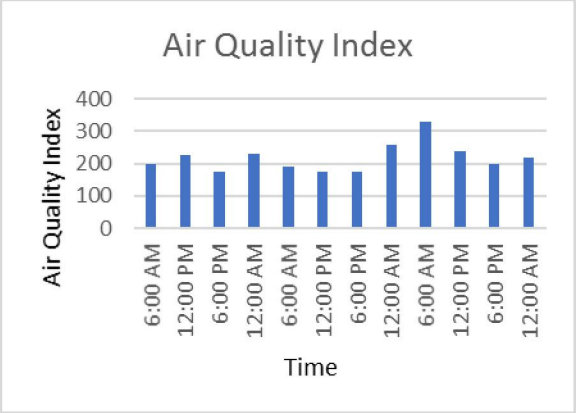

Fig.8.AirQualityindexata fixed Position for72hours

1) Sound Intensity Detection

LM393 Sound Detection Sensor is utilized to measure sound intensity with the motive to monitor Sound Pollution inan area. When the sensor detects sound, it processes the output signal voltage which is sent to Raspberry Pi which again performs the necessary processing required for monitoring the parameters.

2) AnomalyNotification

It acts as an Alert System. In the Raspberry Pi IDE, we use control statements for the incorporation of anomaly notification. If one of the parameters exceeds the desirable range of its digital value, steps are taken to send an Email andSMS to the specific authorities involved. Inside the control statement we give the proper mail body or SMS body, which needs to be addressed for an anomaly. Thus, when any such anomaly occurs, addressing is taken care of, by the system itself.

IV. CONCLUSION

Humans are considered responsible for this polluted anddangerous environment. This is a major concern for the whole world. Thus, a smart way to monitor the various environmental parameters using a Raspberry Pi module has been discussed in this paper. The concept of IoT helps improve the quality of air, monitor the level of noise, temperature and humidity[12][13].I

tisalow-cost, precise and efficient method of monitoring. The monitoring of accumulated data in the cloud storage helps to analyze the various patterns in the environmental parameters and accordingly notifies the public.

V. FUTUREWORK

Many possible solutions have been high lighted in this paper, as to how we can monitor air and sound pollution levelsalong with humidity and temperature using Internet of Things.Our proposed model gives us real -time data so that we can analyze the environmental parameters. We would like to implement the concept of machine learning soon so that we can forecast the possible environmental data. It gives an estimate of the upcoming weather conditions and creates awareness amongst the public.

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IJTE
ISSN: 2057-5688