International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 04 | Apr 2019 www.irjet.net p-ISSN: 2395-0072

PureLiv: Smart Indoor Air Quality Monitoring and Purifying System

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Abstract - *As the lifestyle is becoming more and more modernized, most of the activities are done indoor. From sports to parties, around 80 percent of the time people remain indoor. And in some cases indoor air quality is 80 percent more polluted than outdoor air quality. The majority of gases present in our environment are CO2, NH3, benzene which pollutes the air. To overcome this effect of bad air quality, an air quality monitoring system with a purifier is required. The proposed solution is to measure indoor Air Quality Index (AQI) as well as other harmful contents present in environment like smoke and LPG. The system can be operated anywhere as it can be accessed using a smartphone and all the data is uploaded using cloud computing. Then the indoor air quality will be always clean enough to breath.*

Keywords - ***AQI*** **–** Air Quality Index, IoT – Internet of things, HEPA – High Efficiency Particulate Air

1. INTRODUCTION

In computer technology and communication technology, Networking and information technology has become the important direction of control and measurement field. With the help of today's equipment it becomes easier to design environmental monitoring systems which can monitor quality index in real time. Nowadays, air pollution is a very major problem, whether it is a rural area or urban. As most of the industrial activities get attracted towards cities, it results in increase of air pollution in most of the developing cities. The proposed solution in this paper is based on arduino. The arduino board connects with remote server platform using Wi-Fi module. To measure the air quality index various sensors will be used. A LCD screen will be used to display the AQI value measure by sensors and will command air purifier if the air quality reaches the giver threshold value. Major harmful gases which are present indoor are CO2, NH3, benzene and smoke, the sensor MQ-135 is used to measure the overall AQI. Other than that MQ-7 is used to measure concentration of carbon monoxide and MQ-6 is used to detect LPG concentration in the surroundings. The pollution level of the environment can be measured form anywhere as the system is android application operated. The purifier can be turn on or off from anywhere using smartphones.

The overall graphical representation of various gases as well as history of collected data can also be viewed on smartphone, as the system uses cloud computing. The aim of proposed system is to develop a smart air quality monitoring and purifying system. The time people spend in indoor activities accounts for eighty percent. Air quality indoor has a great effect on human health. At present, widely used environmental monitoring equipment in the market is designed only to monitor environment, not support such appliances as humidifier and air purifier. Therefore, it is impossible to improve the quality of environment according to the results from real-time environmental monitoring equipment. Based on this requirement, the smart air quality monitoring equipment designed in this paper not only help people be well aware of environmental parameter whenever necessary but also provide extended interfaces for other devices. With these extended interfaces, the control for other air purifying equipment can be accessed as an air purifying filter is proposed in this paper. Then the air quality would be always excellent indoor.

2. LITERATURE SURVEY

Previous work done on this field is only to monitor the indoor air quality [1-2]. In which various sensors are used to get the data of different gases present in the environment. In addition of that is can control the working of any filter. The author of the paper followed the process of monitoring the air quality as well as temperature and humidity using temperature and humidity sensor.

Similarly the work is done other forms. In [2] used the air monitoring system to determine the air quality by using various sensors of temperature, humidity, gas concentration and light intensity. After analysing the air quality it allow user to operate his different household equipments to switch them on or off and adjustments [3].

But there are some problems with this method. User need to operate household equipment or filter manually, after the monitoring system notifies them about the bad air quality. There are some scenarios where user would not be able to operate the equipment or filter. Like while they are sleeping and there is some gas leakage, they would not be able to turn the filter or equipment on or off. Similarly if we attach an air filter with the monitoring system it cost too much as filters present in the market are too expensive [4-7].

Related previous work is based on UAV (unmanned aerial vehicle) which is used to monitor the indoor air quality in the buildings [6].By only gathering the data the system will give the necessary precautions for controlling the increasing bad air quality.

The vehicle used is very expensive as well as hard to maintain. The UAV will gather the air quality with attached various sensors.

3. PROPOSED WORK

In this paper the system tried to reduce the human effort in this paper by attaching the filter with the air quality monitor. It provide an air filter which consists a HEPA (High-Efficiency Particulate Air) filter, having life of 1000 hours. The aim of this project is to develop a smart air quality monitoring and purifying system. The time people spend in indoor activities accounts for eighty percent. Air quality indoor has a great effect on human health. At present, widely used environmental monitoring equipment in the market is designed only to monitor environment, not support such appliances as humidifier and air purifier. Therefore, it is impossible to improve the quality of environment according to the results from real-time environmental monitoring equipment.

Based on this requirement, the smart air quality monitoring equipment designed in this project not only help people be well aware of environmental parameter whenever necessary but also provide extended interfaces for other devices. With these extended interfaces, the control for other air purifying equipment can be accessed as an air purifying filter is proposed with the monitor in this project. Then the air quality would be always excellent indoor.

To make the detector work MQ 135 gas sensor is used which is capable of detecting majority of the harmful gases such as carbon monoxide, smoke, NH3 etc., which would help to detect and update the value of the air quality of the environment. An LCD screen displays the quality index. An Air Purifier is attached to the detector which starts purifying the air whenever the quality of air decreases by a given threshold value and inform it to the purifier. The purifier will work until the air quality of the environment comes to normal.

As well as if the user is away from home, they can still access the system using their smartphone as the system uploads the data through cloud computing and can be accessed by user on their smartphone. User will be able to analyse the indoor air quality of the place where system is installed and can turn the purifier on or off if required.

4. IMPLEMENTATION AND RESULTS

For implementation of quality monitoring system, Arduino Uno is used. It takes three important phases to implement the whole system. In first phase, system is initialized and command sensor to start taking real time data. Second phase works on comparing the data to our given conditions that is if the quality of air is more than given threshold value it will send a message to air filter to initialize. Third is where air filter starts purifying the air until the air quality index comes to normal or in breathable environment.

A. Step – 1 (Initializing the system and sensors)

Accuracy of the sensors to read the air quality efficiently is a major phase of the framework. A LCD shows a welcome message as for the initial implementation and sensors start taking reading of air quality. As first value is given by sensor to the system, the value of quality index was shown in the LCD. In every 5 seconds sensor took and update the index value to the system and display it on the LCD. As the sensor is capable of detecting all major gases, combine air quality index is provided by it.

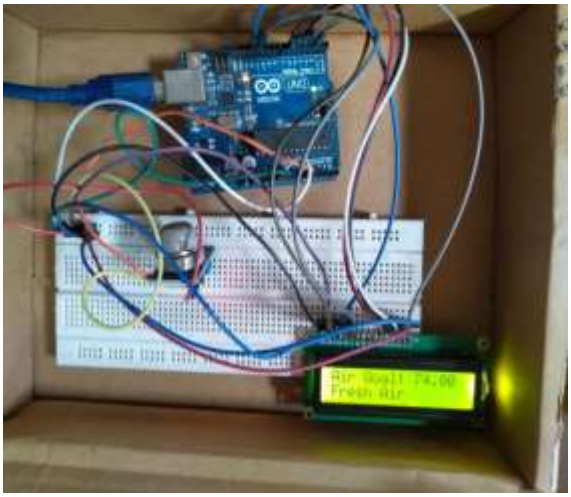

Fig - 1: Reading and displaying air quality index

B. Step-2 (Comparing data to given values)

As the system gets the index value it is compared with the normal quality index values given by us.

The standard Air Quality Index value are given below with the meaning to their corresponding values.

Table – 1: Air Quality Index

Air Quality Index	Numerical Value	Meaning
Good	0-50	Air quality is satisfactory (Little or no risk).
	51-100	Air quality is

Moderate		acceptable.
Unhealthy for sensitive groups	101-150	Health effects may be experienced by members of sensitive groups.
Unhealthy	151-200	Everyone begin to experience health effects;
Very Unhealthy	201-300	Health alert; everyone may experience more serious health effects.
Hazardous	>300	Health warnings or emergency conditions.

As shown in the table 1, AQI have different values on which air affects people differently. After getting the AQI values, the system compare those values to the given values. If the AQI value is above 100 it automatically starts the air filter .For the system given in this paper, the above values of AQI are taken and sent to the system for further steps.

C. Step-3 (Purifying air)

The system is consists of an air filter. The air filter starts working when the system commands it to do if the air quality is bad. The process of purifying the air would be continue until AQI value comes back to moderate or below. As the system measures value in every 5 seconds, it make the air filter efficient. As the AQI comes back to normal filter stops the process of air purifying and come to an idle state.

Table – 2: Action of air filter at different values

AQI	**Action**
0-50 (good)	Idle
51-100 (moderate)	Idle
101-150 (unhealthy for some groups)	Active
151-200(unhealthy)	Active
201-300(very unhealthy)	Active
>300(hazardous)	Active

There are sensors all around, in our homes, smart phones, automobiles, city infrastructure, and industrial equipment. Sensors detect and measure information on all sorts of things like temperature, humidity, gases and pressure. And they communicate that data in some form, such as a numerical value or electrical signal. In this IOT project, you can monitor the pollution level from anywhere using your computer or mobile. ThingSpeak enables sensors, instruments, and websites to send data to the cloud where it is stored in either a private or a public channel. ThingSpeak stores data in private channels by default, but public channels can be used to share data with others. Once data is in a ThingSpeak channel, you can analyse and visualize it, calculate new data, or interact with social media, web services, and other devices.

Other than all the automatic operations of the system, the proposed work allow user to access the system using their smartphone from anywhere, even if they are away from the system. Cloud computing is one of the latest technologies in the world of information technology. With using that the proposed system becomes purely mobile and able to upload the gathered data from sensors to server using cloud computing. It helps to show the real time data as well as previous data on the android application linked to the system easily.

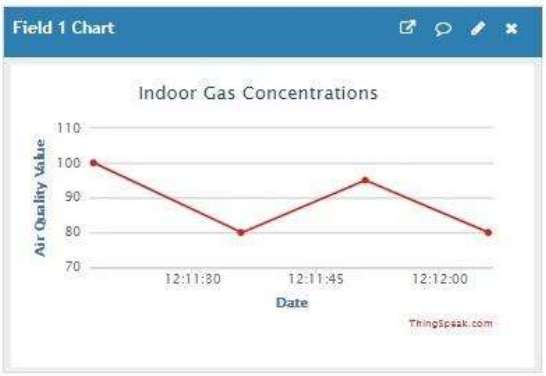

Chart-1: Graphical representation of Overall Air Quality on Thingspeak server

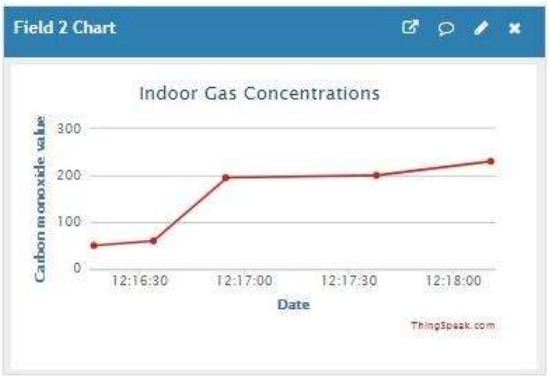

Chart-2: Graphical representation of Carbon Monoxide on Thingspeak server

Chart-3: Graphical representation of LPG value on Thingspeak server

5. CONCLUSION

IOT is a platform which provide to establish network of various things for easy transfer and manipulation of data. This project is proposed to reduce the human efforts in daily routine works and makes it simpler than before. Since the system is fully automated it allow user to analyse the air quality index at each interval of five seconds and starts air filter when air quality index is not suitable to breathe. Even when air quality becomes better and comes back to normal value the system itself turn off the air filter to reduce the use of electricity. One of the important feature of the system is that it turn the air filter on and off by itself, so it helps to increase the life of air filter (HEPA). Air is a natural resource and it is important for us to keep it clean, this system allows us to do the same.

6. FUTURE SCOPE

In future, this work can be continued by adding better ventilation system. It can be controlled efficiently using IOT and controlled by using android application. More security warnings and notifications about air quality will help the user to analyse and control the appliances to make the indoor environment breathable before going in that area.

7. ACKNOWLEDGEMENT

This research was supported by Bhagwan Parshuram Institute of Technology, Rohini, Delhi. We thank our colleagues from BPIT, Rohini who provided insight and expertise that greatly assisted the research.

We thank Ms. Akanksha Dhamija, Assistant Professor, CSE Department, BPIT, for assistance with cloud computing and for comments that greatly improved the manuscript. We would also like to show our gratitude to the Dr. Deepali Virmani, HOD, CSE Department, BPIT, Rohini for sharing their pearls of wisdom with us during the course of this research.

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