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Smart Pollution Monitoring System Using NodeMCU

Atharv Bhagat[1], Yash Bhor[2] , Pranav Kurhade[3], Adhan Sujit[4], Deepali Bhalla[5]

[1]Dept. of Electronics & Telecommunication Engineering, Jaihind PolytechnicKuran, Pune, India
atharvnbhagat@gmail.com
[2]Dept. of Electronics & Telecommunication Engineering, Jaihind PolytechnicKuran, Pune, India
ybhor119@gmail.com
[3]Dept. of Electronics & Telecommunication Engineering, Jaihind PolytechnicKuran, Pune, India
pranavkurhade915@gmail.com
[4]Dept. of Electronics & Telecommunication Engineering, Jaihind PolytechnicKuran, Pune, India
sujitadhan16@gmail.com
[5]Dept. of Electronics & Telecommunication Engineering, Jaihind PolytechnicKuran, Pune, India
deepakhatri09@gmail.com

ABSTRACT—

An advanced system that tracks air pollution in the atmosphere using contemporary technologies like sensors, node mcu, communication networks, and intelligent algorithms is called a smart pollution monitoring system. In comparison to conventional air pollution monitoring systems, the Internet of Things-based system offers a number of advantages. It is capable of gathering real-time data from several sites, which is subsequently examined to determine the pollution sources. Taking the appropriate steps to lessen it is beneficial.

Keywords— IOT, Workstation, Sensors, Smart Environment, ESP8266.

Introduction

The Internet of Things, or IoT, has already impacted many areas of our lives, including the environment. For many years, air pollution has been a serious issue on our planet. To safeguard ourselves against its dangerous effects, a dependable and effective air pollution monitoring system is therefore required.

The best way to get real-time information and insights about the quality of the air in a specific location is with an Internet of Things (IoT)-based air pollution monitoring system. A number of hardware and software elements combine to form an Internet of Things-based air pollution monitoring system, which gathers and processes data. Sensors, microcontrollers, and communication modules are among the hardware elements.

Imagine a system that gathers real-time data from various locations to pinpoint pollution sources. This technology not only helps in taking the right steps to tackle pollution but also sends alerts when air quality dips to dangerous levels, giving users a chance to protect themselves. The Internet of Things (IoT) is key in this fight against air pollution, thanks to its capability to collect real-time information and support smart decision-making. Devices like air quality sensors can keep an eye on pollutant levels in different settings—be it bustling cities, factories, or even our homes. By analyzing this data, we can uncover where pollution is coming from, apply targeted strategies to combat it, and monitor how effective our pollution control efforts are. Plus, IoT-driven smart city solutions enhance transportation, waste management, and energy use, all of which help cut down emissions and boost air quality.

Literature survey

Dwarakanath G.V., Assistant Professor, Department of MCA, BMS Institute of Technology and Management, Bengaluru, India:

In traditional approach, readings of air pollution are checked using different digital air quality detector and moisture meters which has to be taken to different location every time to check the values, it is of time consuming and risk of travelling from one location to another is high. Collection of data has to be done manually. At times the appliances are kept on unknowingly which directly affects the energy consumption, Storage of data are not safe in existing system and data cannot be fetched on time when ever required. There are different air quality identifiable meters available in retail shops such as Am probe meter and Liquid petroleum gas leakage sensor alarm etc. also we have Bluetooth oriented transmitting devices which has a very limited user to find the contamination level in atmosphere.

R. M. Gharat Head of Electronic Engineering Department, Dr. Panjab Rao. Deshmukh Polytechnic Amravati, Maharashtra, India :

Air pollution has a diversified harmful effect on human beings. The changes occurring in the environment and weather have hostile results on flora and fauna. The main reason for the cause of air pollution is the excessive use of energy resources such as natural calamities like volcanic eruptions and forest fires which pollute the air, but the occurrence is less. Hence there is an increase in the level of pollutants in the air as there is a release of pollutants in air. Most countries in Asia are highly influenced by highly concentrated flammable gases. The major air pollutants accountable for affecting human health are smoke and carbon monoxide, Sulphur dioxide, nitrogen monoxide, nitrogen dioxide, and many more. But in recent scenarios, IoT has profoundly overtaken the situation in control as it is used in pollution monitoring systems, e-health, smart cities, etc. Internet of things (IoT) interconnects devices, and the connected devices can communicate wirelessly.

Kishori Deogoankar, Pratik Tambe, Tejas Patil, Shravani Raut, Prathamesh Phulari Department of Electronics and Telecommunication (E&TC) Vishwakarma Institute of Technology, Pune, 411037, Maharashtra, India:

The project entails the development of an Air Pollution Monitoring System, utilizing an ESP8266 microcontroller in conjunction with an MQ2 gas sensor. Its primary objective is to identify and continuously track the levels of various gases, including smoke, LPG, CO, and alcohol, within the atmosphere. The ESP8266 microcontroller serves as the conduit for internet connectivity through Wi-Fi, facilitating seamless communication with the Blink IoT platform, thereby enabling remote monitoring and control of sensor data. The blink library offers a user-friendly interface for interaction with the cloud server, allowing real-time sensor readings to be displayed on a mobile application. The MQ2 gas sensor plays a pivotal role in detecting and quantifying the presence of diverse gases in the air. It measures the analog voltage output from the sensor and transforms it into gas concentration values through the utilization of the 'map ()' function.

Abhishek V*1, Santhosh R*2, Dr. Abhishek M B*3 *1,2student, VLSI & ES, Dayananda Sagar College of Engineering, Bangalore, Karnataka, India *3Asst. prof, ECE, Dayananda Sagar College of Engineering, Bangalore, Karnataka, India Described:

Air Quality Monitoring Benefits us by helping us protect our mother earth and our lives. Air Quality Monitoring is the first step to understand air pollution and Regular Air Quality Monitoring would give us an exact idea about the pollution level in our surrounding and help us protect from various treacherous diseases. The data collected from air quality monitoring helps us assess impacts caused by poor air quality on public health. The data collected from air quality monitoring would primarily help us identify polluted areas, the level of pollution and air quality level. Air quality data helps us determine if an area is meeting the air quality standards devised by CPCB, WHO or OSHA. Air quality monitoring would assist in determining if air pollution control programmed devised in a locality are working efficiently or not. Air quality data helps us understand the mortality rate of any location due to air pollution.

We can also access and compare the short term and long-term diseases/disorders which are a result of air pollution. Based upon the data collected control measures can be devised for protection of environment and health of all living organisms. IoT (Internet of Things) has become an integral part of our lives and it has already made an impact in various sectors, including the environment. Air pollution is a severe problem that has been affecting our planet for years. Therefore, there is a need for a reliable and efficient air pollution monitoring system to protect ourselves from its hazardous effects. An IoT-based air pollution monitoring system is an ideal solution that can provide real-time data and insights about the air quality in a particular area.

Student, Electronics Engineering, Dr. Panjab Rao. Deshmukh Polytechnic Amravati, Maharashtra, India. R. M. Gharat Head of Electronic Engineering Department, Dr. Panjab Rao. Deshmukh Polytechnic Amravati, Maharashtra, India Described:

Every vehicle has its emission of gases, but the difficulty is the emission of the gas outside the uniform values. This emission from the vehicles cannot be completely avoided, but in certain things, we can be able to control this. In this situation, in most countries, air pollution is a major problem. In our life there are three needed necessities are used on earth i.e., air, liquid substances (water), solid substances (food). Before it consumed the water, the water permits through a reliable cleaning process. The main reason for the cause of air pollution is the excessive use of energy resources such as natural calamities like volcanic eruptions and forest fires which pollute the air, but the occurrence is less. Hence there is an increase in the level of pollutants in the air as there is a release of pollutants in air. Most countries in Asia are highly influenced by highly concentrated flammable gases. The processor processes the sensed data from the sensor and communicates it to the server using the internet.

Methodology

- Requirement Analysis and Objective Definition: The first step is to define the purpose of the air monitoring system, such as monitoring air quality for health or environmental purposes. You should also identify the specific pollutants to be measured, such as PM2.5, CO, CO2, NO2, ozone, and temperature or humidity. Next, determine the data collection frequency, whether it will be real-time monitoring or periodic updates. Finally, set the scope of the system, whether it is designed for use in individual homes, urban areas, or large-scale environmental monitoring.
- System Architecture Design: Plan the device components (MQ135 sensors, NodeMCU, DTH 11 sensor , 16x2 LCD Display).
- Hardware & Software Selection: Choose dependable sensors, node mcu, and display. The ESP32 microcontroller will control all the information, receiving sensor Data from the ESP32 and showing it on an display.
- System Integration: Integrate all components for seamless facts series, transmission, and evaluation.

- Testing & Validation: Conduct practical, overall performance, and redundancy assessments to ensure reliability and accuracy.
- Deployment and Maintenance: Once the system is developed, the next step is deployment. The system should be installed in the target locations, such as homes, offices, or outdoor areas. Proper sensor placement is essential to ensure accurate measurements. After installation, you will need to monitor the system remotely to ensure it continues to function smoothly. Ongoing maintenance, including periodic sensor calibration and hardware checks, should be performed to keep the system in optimal condition. Sensors may need to be replaced or recalibrated over time to maintain accuracy.
- Alert System: The system should be able to notify users when air quality exceeds a certain threshold. For example, you might set up alerts to notify users when PM2.5 levels exceed a defined value. Alerts could be sent through email, SMS, or push notifications. Additionally, the system can be designed to trigger automatic actions, such as activating air purifiers or notifying users when the air quality becomes hazardous.

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