"IOT BASED POLLUTION MONITORING SYSTEM"

Aakash S. Pawar[1], Supriya S. Shinde [2],
Prof. (Dr.) Amit Sharma
[1]R.C.Patel Institute of Technology, Shirpur, Maharashtra, India.
[2]S.S.V.P.S. Dr. P. R. Ghogrey Science College, Dhule, Maharashtra, Maharashtra, India.
[3]Oriental University Indore, Madhya Pradesh, India.
**E-Mail: aakashrcpit@gmail.com,* supriya30dec@gmail.com *TP: +91-9405855479.*

Abstract: Internet of Things (IOT) is advanced technique for handling pollution levels in the atmosphere. It is the IoT-based Pollution Monitoring System. This procedure offers accurate, present data about the dissimilar pollutants present in the air, water, and earth by use the power of interacted devices and cutting-edge data analysis tools. The system is made up of sensors that identify and quantify contaminants, IoT devices that gather and send the data to a centralised server or cloud based platform, and a spontaneous interface for data visualisation and analysis. The devices placed in key areas constantly track the levels of contaminants like ozone, carbon monoxide, nitrogen dioxide, particulate matter, and other dangerous compounds. The Internet of Things (IoT) devices serve as data collection points, gathering sensor data and sending it over wired or wireless communication protocols to a centralised server. With the help of sophisticated algorithms and machine learning techniques, the central server or cloud platform processes and analyses the gathered data to produce insightful results. In conclusion, the IoT-based Pollution Monitoring System represents a significant advancement in environmental monitoring and management. By leveraging IoT technologies, data analysis, and visualization, this system offers a comprehensive solution for monitoring pollution levels, enabling informed decision-making, and fostering a healthier and sustainable environment.
Keywords: IOT (Internet of Things); Pollution levels; sensors.

1. Introduction

Publics are becoming worse and the climate is changing in such a way that it has made it difficult for publics to living, affording to the daily reporters and any other electronic or print media. Pollution is the primary cause of climate change and poor health in individuals. This technique was developed with the intention of conducting research on a severe issue and estimating the quality of pollution for humans and other living things.

Researchers are currently evaluating different air pollution monitoring methods. As automated systems are growing increasingly common every day, it is only natural that their primary design objective was to automatically collect environmental data and analyse it using cutting-edge technology. The plan's automatic data collecting and analysis was introduced by the system. We have discovered that this method frequently falls short of accurately detecting the contamination. Due to the prevalence of android operating systems and internet connection in modern society, a server and an android app have been created to keep track of the statistics.

Among the most basic and essential components for human existence is air. The path to a healthy lives is to inhale clean, sound air. The United States' major and most impacting caring right now is air pollution. In general, reasonable pollution levels are unlikely to have any major short-term significances on someone who is young and in decent health. Higher pollution levels and long-term exposure, however, will result in more severe symptoms and bugs that are harmful to social health. This has an impact on more than just the inflammatory response and metabolic systems.

2. Review of Literature

The recommended mentioned system includes two main components: an Internet-Enabled Pollution inspecting Server and a Mobile Data Acquisition Unit (Mobile-DAQ). Let's explore each component in more detail:

2.1 Internet-Enabled Pollution Inspecting Server:

This server acts as the vital hub for assembling and handling smog-related data. It is intended to be unbreakable and capable of handling large amounts of data. The server is connected to the internet, allowing it to communicate with the Mobile-DAQ units and other devices in the system.

2.2 Mobile Data Acquisition Unit (Mobile-DAQ):

The Mobile-DAQ is a portable device that collects pollution data in real-time. It integrates several components to facilitate its functionality:

2.3 Global Positioning System Module (GPS-Module):

This module enables the Mobile-DAQ to determine its precise geographical location using signals from GPS satellites. It provides accurate location data, which can be used to correlate pollution measurements with specific locations.

2.4 General Packet Radio Service instrument (GPRS instrument):

The GPRS instrument allows the Mobile-DAQ to transmit data over the internet. It enables communication between the Mobile-DAQ and the Pollution Inspecting Server, facilitating the transfer of collected pollution data.

2.5 Pollution Sensor Array:

The Mobile-DAQ incorporates a sensor array specifically designed to measure and detect various types of pollutants in the environment. These sensors can detect parameters such as air quality, particulate matter, gases, and other relevant pollutants.

2.6 Single-Chip Microcontroller:

The single-chip microcontroller acts as the brain of the Mobile-DAQ, coordinating the operations of different components and facilitating data acquisition, processing, and transmission. It ensures efficient and reliable functioning of the device.

Overall, this recommended system allows for efficient and continuous monitoring of pollution levels in various locations. The Mobile-DAQ units collect real-time pollution data using the integrated sensor array, along with GPS information for accurate location tracking. The collected data is then transmitted to the Internet-Enabled Pollution Inspecting Server through the GPRS instrument, enabling centralized storage, analysis, and visualization of the pollution data.

The Smog-Server could be a high-end processer or computer application server with net property. The Mobile-DAQ element collects air pollutants levels (CO, NO2, and SO2), and packs them into a vary frame with the GPS physical location, time, and date. The arrangement is subsequently uploaded to the GPRS-Modem and conveyed to the Pollution-Server via the broad community mobile network. The Pollution-Server is linked to an information server which updates the pollution level for a broader spectrum of consumers, include insurance companies, automobile registration workplaces, and sustainability organisations. The Pollution-Server combines with Google Maps to show present levels of pollution and their precise locations in large urban areas. The technology has successfully undergone testing in the city. The system offers 24-hour/7-day reports on the location and level of period pollutants. [1]

The present research proposes the Pollution-Sense system for monitoring and decreasing air pollution. The system's primary goal is to provide people access to the pollution status so that they are able to deal to their specific issues. An enormous amount of pollutant information have to be offered by Pollution-Sense in time as well as space, at different granularities. Members of the government will be allowed to monitor and manage the Air Quality Index of a nation, state, or city. The most significant components of the structure are also described, including the sensing devices, first level integrator, graphical user interface, software architecture, individual client and server modules, and the data visualisation module. [2]

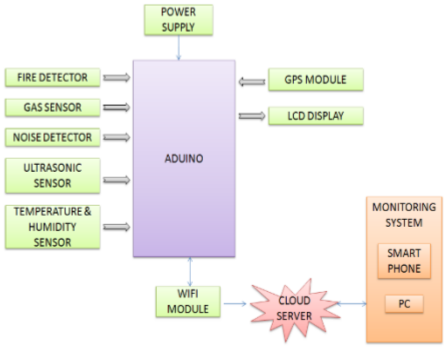
The theme of home automation that this paper presents would remotely live electrical parameters and manage household appliances. The united arrangement will let the residents avoid using different systems to track their home usage. The resident's preferred laptop or iPad device is frequently used to operate the systems. Installing Smart sensing modules and establishing a ZigBee-based WSN at a few homes allows the system's intended functionality to be tested. [3]

This paper aims to present the creation of an all-inclusive, low-cost technological solution capable of measuring CO, CO2, and dust density (i.e., the number of airborne particles per cubic metre), wirelessly transmitting the composed data in real-time, storing it in a relational database, and displaying this data in a Web application. This entails putting together hardware and software that can communicate with one another. [4]

This paper aims to present the creation of an all-inclusive, low-cost technological solution capable of measuring CO, CO2, and dust density (i.e., the number of airborne particles per cubic metre), wirelessly transmitting the composed data in real-time, storing it in a relational database, and displaying this data in a Web application. This entails putting together hardware and software that can communicate with one another. [5]

3. Methodology

The formation of a kit that will be located in the required position for checking is the focal goal. The kit will mainly contain of an Arduino, which will be used to arrange all the sensors, a Wi-Fi module for data transfer, and a GPS module for location finding. The Wi-Fi unit will send every analysis that the kit has taken to the server. Data from numerous positions are exposed utilising scientific and user-responsive methods, such as on a PC or smart mobile. When the pollution level betters the usual range threshold value, the appropriate specialists subject real-time warnings.



.

Fig.1. Block diagram of proposed system

3.1 Arduino Mega

The ATmega2560 microcontroller is backed by this board. It contains 64 unoriginal inputs, 4 UARTs (hardware serial ports), a crystal oscillator with a frequency of 16 MHz, 54 digital input/output pins (14 of which will be used as PWM outputs), an USB port, a power jack, a header for ICSP, and a reset switch. It includes anything desirable to support a microcontroller; for getting started, just connect it to a laptop with a USB cable, or power it with an AC-to-DC adapter or battery..

3.2. MQ2 gas device

The sensor in question has an identifying element composed primarily of ceramic with an aluminum-oxide base and a tin dioxide covering that is enclosed in a stainless steel mesh. Sensing element is held up by six connecting legs. The sensing element is warmed by two leads, while the other four are used to generate output signals. When a sensing material is heated to a high temperature in air, oxygen becomes adsorbed on the substance's surface. Donor electrons from the tin chemical complex then flow to this chemical element, stopping the flow of current.

3.3 Sound sensing element module

It offers an easy method for understanding sound and is usually used for sound intensity detection. Applications involving security, changing, and observation will make use of this module. For ease of use, its accuracy will be simply altered. It makes use of a microphone to supply the input for related gadgets like a peak detector and buffer. When a sound is detected, the detector analyses the associated output voltage and sends it to a microcontroller, where the relevant operations are then carried out.

3.4 Ultrasonic Distance Sensing Element

The Flame Detector Sensor Modules is able to detecting either regular light or flames. Frequently employed as a flame alarm. It can detect a flame or a light source with a wavelength between 760 and 1100 nm. It is sensitive to the flame spectrum and has a detection range of within 60 degrees. Its sensitivity could have adjusted and works reliably.

3.5 IR Based Fire Detection Sensing Element Module

The Flame Detector Sensor Modules is able to detecting either regular light or flames. Frequently employed as a flame alarm. It can detect a flame or a light source with a wavelength between 760 and 1100 nm. It is sensitive to the flame spectrum and has a detection range of within 60 degrees. Its sensitivity could have adjusted and works reliably.

3.6 Temperature and Wetness sensing element

The DHT11 may be a simple, absurdly cheap digital humidity and temperature detectors. It detects the amount of moisture in the air surrounding it utilising an electrical phenomenon humidness detector and a thermister, then spit out an electronic signal on the information pin (no conventional input pins are needed). While it is reasonably simple to use, exact temporal preparation is needed for gathering information. The only significant drawback of this detector is that it is able to supply you with fresh information once per second. As a result, whereas utilising the library's resources, detector readings are sometimes up to two seconds out of date.

3.7 WI-FI module

A inexpensive Wi-Fi microprocessors with a full TCP/IP stack and microcontroller capabilities, the ESP8266 was created by Shanghai, China-based firm Espress ion Technology. With the ESP-01 module, manufactured by a third party supplier, the chip initially attracted the interest of Western companies in the month of August 2014. Using the aid of Hayes-style directions, this small module allows microcontrollers to connect to wireless internet networks and establish simple TCP/IP connections. However, early on, there was very little English-language information available about the chip and the instructions it supported. Many hackers became attracted to the module, chip, and package on it in addition to transforming the Chinese documentation due to its extremely low price and the fact that it had so few external parts, which implied that it could ultimately be produced at a very low cost per unit. The ESP8285 is an ESP8266 with one MB of intrinsic flash, enabling single-chip Wi-Fi connectivity for devices.

3.8 GPS receivers

mobile devices, fleet management platforms, military use, etc. usually use GPS receivers to track or detect location. The Global Positioning System (GPS) is a satellite-based system that determines and measures its position on Planet utilising ground-based stations and satellites. Guidance Systems involving Time and Travel GPS is another name for GPS. For accuracy, a GPS receiver requires data from at least four satellites. The satellites receive no data from the GPS receiver. This GPS receiver is used in a variety of applications, include fleet management, cabs, and smartphones.A GPS receiver determines its precise location regardless of where it is through a constellation of satellites and ground stations. The receiver receives data signals from the GPS satellites at frequencies between 1.1 and 1.5 GHz.

3.9 Liquid Crystal Display 16×2

The liquid crystal display can not actually release light; rather, it makes advantage of liquid sunlight viewing abilities. A flat panel display or an electronic illustration display could both be liquid crystal displays. Low information LCD content is produced in the form of a fixed picture or an arbitrary image that is either apparent or undetectable, such as the existing words, numbers, or 7 segment display. Uninformed pictures have a lot of tiny pixels, and the element contains bigger pieces.

3.10 Software

Using the Arduino Integrated Development Environment (IDE), integrated C code is executed to turn on the Arduino controller. The no cost, integrated tools and atmosphere known as Arduino (IDE) may be used to programme the Arduino processor. The controller receives the programme instructions via a USB wire.

3.11 Blynk

Think of your cell phone as a test board where you can drag and drop buttons, sliders, screens, graphs, and other helpful widgets. And after a few minutes, these widgets will control Arduino and collect data from it. Using the Internet, Blynk operates. Thus, the only need is that your gear make use of the internet. Blynk libraries and sample sketches can get you online, connect to Blynk Server, and combine with your smartphone regardless of the type of connection you choose, whether it LAN, WI-FI, or even this new ESP8266 everyone seems to be talking about.

4. Advantages

- Toxic gas detection is relatively simple.
- Cost-effective.
- Circuit is less difficult.
- Because of its Internet of Things foundation, remote access is feasible.

5. Applications

- It may be utilised by government agencies or by any sector that regularly checks the level of pollution in the environment.
- Industry-related pollution can be frequently checked.

6. Result and Discussion

We carried out the study after connecting and programming each component to work with the others. We have created a prototype Internet of Things-driven pollution monitoring system that complies with the suggested method. The sensors, the GSM module, and the Arduino are all connected together.

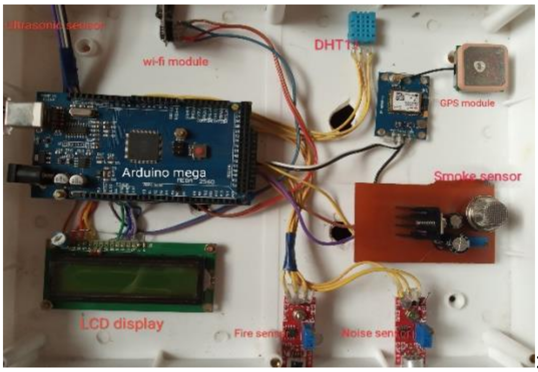


Fig.2. Top view of whole system.

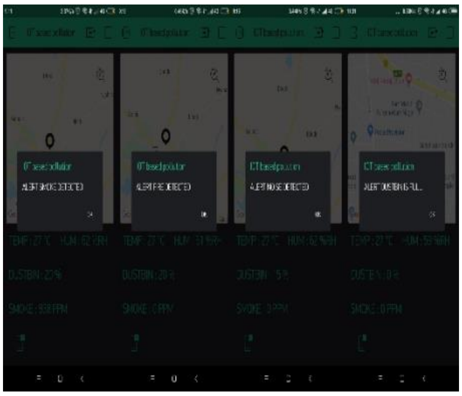


Fig.3. Alert of smoke fire; noise detected and dustbin full

Information is collected via the Arduino from multiple sensors. The kit's surrounds are tracked for pollution with the sensors placed in different places. With the help of the Wi-Fi module, these sensor measurements are sent to the server. The data is displayed on a The Blynk programme. If the sensor values fall within the permissible range, they appear on the LCD display and the mobile device. In order to inform users to avoid highly polluted places, an alert message is presented on the Blynk application if the readings from the sensors surpass the threshold value.

To make it possible monitoring to take place at any time and from any place, we included a live pollution monitoring system in our project. Android phones are necessary for this. Using the Blynk app, which is available in the Google Play store, one can broadcast live. Another individual may then log into an account and see the live status.

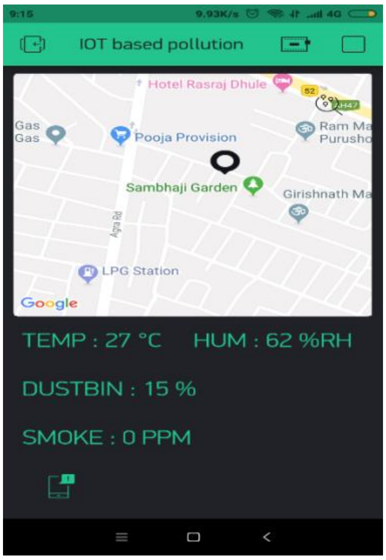


Fig.4. Map showing system location

7. Conclusion

Utilising the internet of things, a pollution monitoring system was created, put into reality, and tested. The setup is used to gather pollution from the environment. A central server collects environmental data from multiple sensors and sends it to authority. The objective was to develop an internet-based real-time tracking system for combating pollution. The model made up a computer system with an n-layer architecture, open-source hardware, and cheap software. In addition, a software part was created and programmed in the C/C++ language to enable data transmission. We needed to lower market prices and offer more affordable solutions with this software look at and the utilisation of Arduino-based hardware. In the years to come, our device might continue to be checked to see if the sensors are still working while offering real-time data. The hardware devices can have a light system added to it. The illumination system is going to function automatically. For instance, each of the four types of gases has its own light. When a specific sensor detects a gas, the corresponding light next to that gas will turn on, and when the sensor no longer detects that specific gas, the light will turn off automatically.

References

[1]. R. Al-Ali , Imran Zualkernan, Fadi Aloul, “A Mobile GPRS-Sensors Array for Air Pollution Monitoring” IEEE sensors journal, vol. 10, no. 10, (OCTOBER 2010).

[2]. Diego M´endez_, Alfredo J. P´erez_, Miguel A. Labrador, Juan Jos´e Marr´ony, “P-Sense: A Participatory Sensing System for Air Pollution Monitoring and Control” IEEE (2011).

[3]. Sean Dieter Tebje Kelly, Nagender Kumar Suryadevara, and Subhas Chandra Mukhopadhyay, “Towards the Implementation of IoT for Environmental Condition Monitoring in Homes” IEEE sensors journal, vol. 13, no. 10, (OCTOBER 2013).

[4]. Walter Fuertes, Diego Carrera, César Villacís, Theofilos Toulkeridis, Fernando Galárraga, Edgar Torres, Hernán Aules ,“Distributed System as Internet of Things for a new low-cost, Air Pollution Wireless Monitoring on Real Time”. IEEE (2015).

[5]. Petros Spachos, Dimitrios Hantzinakos, “Real-Time Indoor Carbon Dioxide Monitoring through Cognitive Wireless Sensor Networks Senior”, IEEE (2015).

[6]. M. S. Jamil, M. A. Jamil, A. Mazhar, A. Ikram, A. Ahmed, U. Munawar,“Smart Environment Monitoring System by employing Wireless

Sensor Networks on Vehicles For Pollution Free Smart Cities" Humanitarian Technology: Science, Systems and Global Impact 2015, HumTech (2015).

[7]. Y. J. Jung, Y. K. Lee, D. G. Lee, K. H. Ryu, S. Nittel, "Air pollution monitoring system based on geosensor network," in Proc. IEEE Int. Geoscience Remote Sensing Symp., (2008).

[8]. Y. Kim, M. Kim, J. Lim, J. Kim, C. Yoo,"Predictive monitoring and diagnosis of periodic air pollution in a subway station", Elsevier, Journal of Hazardous Materials. (July 2010).

[9]. K. Kaur, S. C. Mukhopadhyay, J. Schnepper, M. Haefke, H.Ewald, "A Zigbee based wearable physiological parameters monitoring system," IEEE Sensors J., vol. 12, no. 3, (Mar. 2012).

[10]. Kadri, Yaacoub, Mushtaha, Abu-Dayya. "Wireless Sensor Network for Real-Time Air Pollution Monitoring". Qatar Mobility Innovations Center, IEEE (2013).

[11]. C. Peng, K. Qian, C. Wang, "Design and Application of a VOC Monitoring System Based on a ZigBee Wireless Sensor Network," Sensors Journal, IEEE, vol. 15, no. 4, (Apr. 2015).

[12]. Amnesh Goel, Sukanya Ray, Prateekand Nidhi "Air Pollution Detection Based On Head Selection Clustering and Average Method from Wireless Sensor Network" IEEE (2012).

[13]. Boubrima A, Bechkit W H, Rivano, Optimal WSN Deployment Models for Air Pollution Monitoring, IEEE Transactions on Wireless Communications, (2017).

[14]. Gupta P, Kumar R, Singh S.P and Jangid A, "A study on monitoring of air quality and modeling of pollution control", IEEE, (2016).