



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Iot Based Weather And Air Pollution Monitoring System Using Raspberry Pi PICO

¹V. Vijaya Durga, ²J. Mahitha, ²P. Pavani, ²P. Nikitha, ²M. Johnson

¹Assistant Professor, Department of computer science and engineering, SRK Institute of Technology, NTR, Andhra Pradesh, India

²Students, Department of computer science and engineering, SRK Institute of Technology, NTR, Andhra Pradesh, India

ABSTRACT:

With the rapid growth of urbanization, industrialization, and vehicular traffic, air pollution and changing weather patterns have emerged as critical environmental concerns. This paper presents the design and implementation of an IoT-based Weather and Air Pollution Monitoring System using the Raspberry Pi Pico microcontroller. The system is equipped with a suite of environmental sensors to measure key parameters such as temperature, humidity, and concentrations of harmful gases including CO₂. Using the Wi-Fi module, real-time data is transmitted to a web server for remote monitoring. The system provides air quality readings in Parts Per Million (PPM) and defines them into qualitative levels—such as “Fresh Air” and “Poor Air”. These readings, along with weather data, are displayed simultaneously on an LCD screen and on Things View Application. This paper demonstrates the practical application of Internet of Things (IoT) technology for real-time, low-cost, and efficient environmental monitoring. This paper explains the depiction and execution of an Air Pollution detection system. The innovation grasped here, is a handsome execution of the idea of Internet of Things. This detailed work is an exploration of the possibilities of consumption of this innovation. In this world, where natural wellbeing is turning into a genuine risk.

KEYWORDS: IoT, Raspberry Pi Pico, Air Pollution Monitoring, Weather Monitoring, Environmental Sensors, Real-Time Data, Wi-Fi Connectivity.

INTRODUCTION:

This paper involves the creation of an intelligent environmental monitoring system that utilizes the Internet of Things (IoT) framework to monitor weather conditions and air pollution levels in real-time. With the mounting crisis of air pollution caused by urban sprawl, industrial outputs, and car usage, there has been a pressing need for effective and accessible monitoring systems. The proposed system seeks to narrow the gap between environmental data capture and public awareness by providing a low-cost, easy-to-use, and real-time option.

Central to the system is the “Raspberry Pi Pico”, an efficient and lightweight microcontroller that communicates with other sensors. They are gas sensors such as “MQ135”, temperature and humidity sensors, and a Wi-Fi module (ESP8266). The sensors collect environmental parameters such as CO₂, NH₃,

and particulate matter levels, and atmospheric conditions like temperature and humidity. The microcontroller processes this information and interprets it in meaningful values, usually in the form of Parts Per Million (PPM).

To provide real-time access, the system sends data to a cloud platform via the Wi-Fi module. The data is then graphically presented on ThingSpeak, an IoT analytics cloud service, allowing users to see trends and live values via the web. An LCD screen also shows the present air quality status locally, utilizing labels such as "Fresh Air" or "Poor Air," providing on-the-spot awareness.

To further enhance accessibility, an Android application has been created as part of the system. The application enables users to monitor live pollution levels and weather conditions in their area. It serves as a personal environmental assistant, providing updated information in an easy-to-use interface. Through the integration of cloud services and mobile platforms, the system is highly scalable and useful for real-world applications.

Overall, this paper highlights the power of IoT to address real-world environmental challenges through smart, networked technology. Not only does the system deliver accurate, real-time information, but it also gives communities the power to remain knowledgeable about their environments. With potential future additions such as vehicle emissions detection and range extension communication, the system is poised for widespread deployment and ongoing innovation in environmental monitoring.

LITERATURE REVIEW:

Ashfaquul et al., [1] "IoT Based Air Quality and Weather Monitoring System with Android Application" international Conference on Innovations in Science, Engineering and Technology (ICISSET) 26-27 February 2022. This system utilizes an Arduino microcontroller interfaced with various sensors to collect data.

Ms. Sarika Deshmukh et al.,[2] "Air and Sound Pollution Monitoring System using IoT" International Journal on Information Theory (IJIT), Vol-5, Issue-6, 2017. The system integrates distributed sensing units and information systems to reliably and accurately measure parameters using sensors and transfer data via the internet.

Deva hema et al.,[3] "IOT based Air Pollution Monitoring System", Journal of Network Communications and Emerging Technologies (JNCET), Vol-8, Issue-4, 2018. The system includes an alert mechanism that notifies users when gas concentrations exceed safe limits, enabling timely action to protect health and improve environmental awareness.

L. Ezhilarasi et al.,[4] "A System for Monitoring Air and Sound Pollution using Raspberry pi pico Controller with IOT Technology", International Journal on Information Theory (IJIT), Vol.-3 Issue-2, 2017. This study presents an IoT-based system utilizing an Arduino controller to monitor real-time air and sound pollution levels. The system employs various sensors to detect environmental parameters, transmitting the collected data to a cloud platform for remote access and analysis. This approach aims to provide an efficient and cost-effective solution for continuous environmental monitoring, contributing to public health and safety.

EXISTING SYSTEM:

In the being system, air pollution monitoring is limited to the specific point where the device is physically installed. The system senses the actuality of dangerous feasts in the air using gas detectors and shows the corresponding information locally on an TV display. This means that real- time air quality data are only accessible to individualities who are physically near the device. also, if the attention of adulterants exceeds some are pre-determined safety thresholds, the system is programmed to spark an alarm by delivering a communication to the sanctioned people through a GSM module. Indeed, though this setup provides introductory functionality for seeing and responding to inordinate pollution situations, it is not scalable or affordable. The absence of web- grounded or pall integration access restricts its capability to give real- time air quality data to the millions, similar as the general public, experimenters, or government agencies. Secondly, since the system is insulated, it does not contribute to a centralized network of monitoring, which is essential for large- scale environmental monitoring and analysis.

PROPOSED SYSTEM:

The paper aims to develop an IoT based weather and air pollution monitoring system that can be installed in a locality and to upgrade the system from the systems already developed overcoming the past disadvantages by creating an android application accessible to the public. Anyone can use this app to receive live updates regarding the pollution in their area. It employs Raspberry pi Pico combined with single gas sensors such as carbon monoxide, ammonia and particulate matter, humidity, and smoke measuring the concentration of each gas individually. The data acquired is pushed into the cloud via thing speak platform at fixed time intervals. Ethernet shield is utilized for communicating Raspberry pi Pico and cloud. Pictorial or graphical values can be displayed in Thing speak. The users can download an android app by means of which they receive the latest updates and graphical data up to date. The average concentration of the gases is analyzed by MAT Lab. Then some time control is allotted based on the standard level of each gas as recorded and the result can be observed in android app as well as on LCD display.

METHODOLOGY:

The approach to this design is through the development and integration of an IoT- grounded air quality and rainfall condition monitoring system exercising a jeer Pi Pico microcontroller. Detectors similar as the MQ135 gas detector, temperature detectors, and moisture detectors are connected to the Raspberry Pi Pico to acquire environmental data. The detectors measure dangerous feasts similar as CO₂, NH₃, benzene, and bank, as well as temperature and moisture. The detector readings from the analog detectors are handled by the microcontroller, digitalized and also displayed on a 16x2 TV. At the same time, the ESP8266 Wi- Fi module sends the data to the ThingSpeak cloud platform for remote access and graphical representation. There's a buzzer for startling the stoner in case of inordinate gas attention above safe situations. The information is also made available via specially designed Android app, in which druggies are suitable to track in real- time pollution situations and rainfall conditions for where they're located. This concerted system allows for ongoing, position- grounded monitoring and mindfulness creation via original and web- grounded platforms, furnishing a cost-effective and effective system for managing the terrain.

HARDWARE COMPONENTS AND IMPLEMENTATIONS:

Weather and Air Pollution Monitoring System Using Raspberry PI PICO W a combination of sensor components that enhance its functionality. The primary hardware components include the ESP8266 microcontroller, MQ Sensors (2,3,7,8,135), DHT-11, 0x27 LCD.



Fig 1: ESP8266
Microcontroller



Fig 2:
MQ-135 Sensor



Fig 3: MQ-2
Sensor



Fig 4: MQ-3
Sensor



Fig 5: MQ-7 Sensor



Fig 6: MQ-8 Sensor

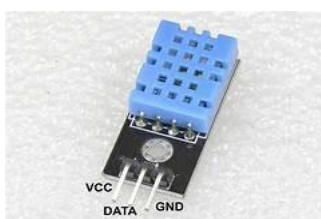


Fig 7: DHT-11
Sensor

- **ESP8266 Microcontroller:** The ESP8266 is selected as the core processing unit due to its high processing power, low power consumption, and built-in Wi-Fi and Bluetooth capabilities. This microcontroller is responsible for handling input from the push button, processing signals, and sending emergency SMS alerts.
- **MQ-135 Sensor:** MQ-135 gas detector can be used to detect the bank and other poisonous gases. It's able to detect colorful dangerous gases, similar as NH₃, NO_x, alcohol, benzene, bank and CO₂. MQ135 gas detector is largely sensitive to Ammonia, Sulfide and Benzene fumes, which are also responsive to bank and other poisonous gases. This Module utilizes the MQ-135 air quality detector chip and dangerous gas detector chip.
- **MQ-2 Sensor:** The MQ-2 sensor is a widely used and versatile gas sensor with a reputation for its sensitivity to detect a broad array of combustible gases with fast response and good sensitivity. The sensor is generally utilized to detect gases such as LPG, smoke, methane, propane, hydrogen, alcohol, and carbon monoxide. It is altered when the material is exposed to gases.
- **MQ-3 Sensor:** The MQ-3 sensor has high alcohol vapor sensitivity, and hence it is well-suited for alcohol detection systems and breathalyzer usage. It detects other gases such as benzene and methane as well, albeit with limited response, but works optimally if used specifically to detect ethanol. The sensor features rapid response time, low cost, and seamless integration with microcontrollers such as Raspberry Pi Pico W.
- **MQ-7 Sensor:** The MQ-7 sensor is tuned specifically to sense carbon monoxide (CO) at high sensitivity and stability. It works in a double heating cycle to differentiate CO from other gases to give more accurate sensing in low concentrations. It is cost-effective, easy to work with microcontrollers such as Arduino or Raspberry Pi Pico, and ideal for indoor air quality monitoring and safety applications. In general, the MQ-7 is a reliable option for CO sensing in intelligent and safety-related applications.
- **MQ-8 Sensor:** The MQ-8 sensor is specifically designed to sense hydrogen gas (H₂) with high sensitivity and fast response. It can sense hydrogen concentrations from 100 to 10,000 ppm, making it an ideal sensor for hydrogen leak detection in industrial settings, laboratories, and safety systems. The sensor can be easily interfaced with microcontrollers such as Raspberry Pi Pico W and has only a simple analog voltage reading. Although it is affordable and reliable, it requires suitable calibration and preheating in order to provide accurate readings.
- **DHT-11 Sensor:** The DHT11 sensor is an inexpensive and very popular digital sensor that senses temperature and humidity with moderate accuracy and reliability. It reports temperature between 0°C to 50°C and humidity from 20% to 90%, which can be used in simple environmental sensing in home automation, weather monitoring, and IoT applications. DHT11 is a good option for applications needing basic cost-saving temperature and humidity sensing.



- **0x27 LCD:** The 0x27 TV is a 16x2 I2C TV display module that employs the I2C protocol for communication, which makes it veritably effective for microcontroller operations. Its major benefit is that it only needs two data legs (SDA and SCL) to serve, which means smaller GPIO legs are consumed compared to normal LCDs. The display is readable, low power consumption, and accessible to use, particularly with Raspberry Pi libraries. Overall, the 0x27 I2C TV is a space- saving, provident, and stoner-friendly device for systems that bear a comprehensible visual display with minimum line use.

Fig 8: 0x27 LCD

SOFTWARE DEVELOPMENT AND INTEGRATION:

The software development process involves programming the ESP8266 microcontroller to handle real-time processing and communication. The software is designed to ensure that the system operates seamlessly and responds quickly to user inputs.

- **Thonny IDE:** Thonny IDE is a beginner-friendly Python environment, ideal for students and IoT papers like Raspberry Pi Pico. It features a simple interface, syntax highlighting, step-through debugging, and variable inspection. Lightweight and easy to install, Thonny supports MicroPython, making it perfect for microcontroller programming.
- **MicroPython:** MicroPython is a lightweight Python 3 implementation designed for microcontrollers like the Raspberry Pi Pico. It enables clean, readable code for hardware tasks, supporting GPIO, I2C, SPI, UART, and real-time operations. With its small size and high efficiency, MicroPython is ideal for IoT, automation, and robotics applications.
- **ThingSpeak:** ThingSpeak is a cloud-based IoT analytics platform used to collect, store, analyze, and visualize sensor data in real time. It's popular for Raspberry Pi and ESP8266 papers due to its simple API and MATLAB integration. Users can create channels, plot data, and trigger alerts or actions. Free for non-commercial use, ThingSpeak offers real-time monitoring and is ideal for IoT and remote sensing applications.

RESULTS & ANALYSIS:

The following figures shows the output in our website as well as in Application.

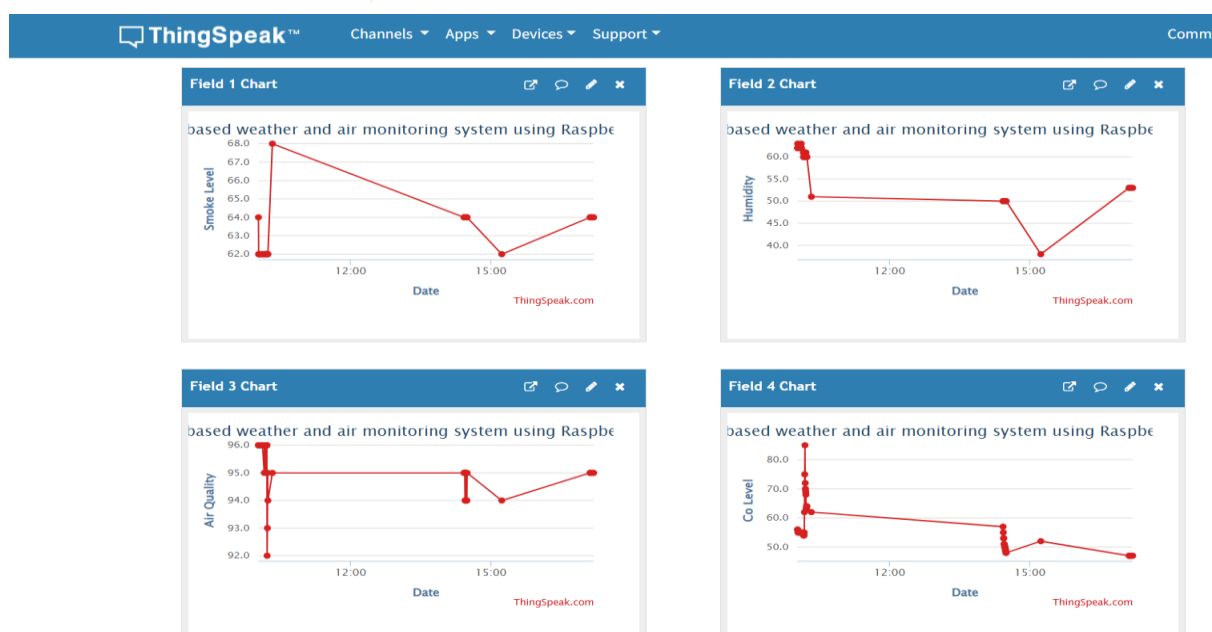


Fig-9: Graph showing the Weather and Gas levels



Fig-10: Results of Smoke Level, Humidity and Air Quality

CONCLUSION:

The system to monitor the air of environment using Raspberry pi Pico microcontroller, IoT Technology is proposed to improve quality of air. With the use of IoT technology enhances the process of monitoring various aspects of environment such as air quality monitoring issue proposed in this paper. Here, using the MQ135 gives the sense of different type of dangerous gas and Raspberry pi Pico is the heart of this paper. Which control the entire process, Raspberry pi Pico module connects the whole process to LCD and serial monitor is used for the visual Output.

FUTURE SCOPE:

The future scope is that device which we are having can be done in a compact way by reducing the size of the device for further implementation or the modifications which can be is that detecting the vehicles amount of pollution which can be determined. In future the range can be made increased according to the bandwidth for the high range frequencies. Further research can be made by making the people in the right direction for their welfare. Therefore, there is another beneficiary by using this device in an app so the all can be used in an GSM mobile phone for their daily updates by increasing their range.

REFERENCES:

- [1] A. Ashfaque et al., "IoT Based Air Quality and Weather Monitoring System with Android Application," in Proc. Int. Conf. Innovations in Sci., Eng. and Technol. (ICISSET), Feb. 26–27, 2022.
- [2] S. Deshmukh et al., "Air and Sound Pollution Monitoring System using IoT," Int. J. Inf. Theory (IJIT), vol. 5, no. 6, 2017.
- [3] D. Hema et al., "IoT based Air Pollution Monitoring System," J. Netw. Commun. Emerg. Technol. (JNCET), vol. 8, no. 4, 2018.
- [4] L. Ezhilarasi et al., "A System for Monitoring Air and Sound Pollution using Raspberry Pi Pico Controller with IoT Technology," Int. J. Inf. Theory (IJIT), vol. 3, no. 2, 2017.
- [5] N. Kaur et al., "Air Quality Monitoring System based on Raspberry Pi Pico Microcontroller," Int. J. Inf. Theory (IJIT), vol. 5, no. 6, Jun. 2016.
- [6] D. Arunkumar et al., "Smart Air Pollution Detection and Monitoring Using IoT," Int. J. Inf. Theory (IJIT), vol. 119, no. 15, 2018.
- [7] Palaghat Yaswanth Sai, "An IoT Based Automated Noise and Air Pollution Monitoring System", International Journal on Information Theory (IJIT), Vol.-6, Issue-3, March 2017.
- [8] Shanzhi Chen, Hui Xu, Dake Liu, Bo Hu, and Hucheng Wang, "A Vision of IoT: Applications, Challenges, and Opportunities with China Perspective", IEEE INTERNET OF THINGS JOURNAL, VOL.-1, NO.-4, August 2014.