International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

IoT Based Continuous Abiotic Factors Monitoring and Statistical Analysis

V V Siva Reddy[1], Varun Sachan[2], Ashwin Himanshu[3], Utkarsh Gupta[4], Savita A. Harkude[5]

[1,2,3,4]Student, Electronics and Telecommunication Engineering, Sir M Visvesvaraya Institute of Technology
[5]Associate Professor, Electronics and Telecommunication Engineering, Sir M Visvesvaraya Institute of Technology

Abstract
Air and water purity are fundamental factors influencing human health and well-being. However, contemporary circumstances have caused these essential resources to be widely contaminated with contaminants, which has caused a number of health issues, including respiratory illnesses, cancer, and birth defects. In industrial settings, the situation is exacerbated as the contaminants present in the air and water can significantly impact manufacturing processes due to the high reactivity of the industrial ingredients. This research project aims to address this issue by utilizing IoT sensors to monitor air and water quality in industrial environments. Data on a wide range of contaminants, including particulate matter, ozone, and nitrogen dioxide, will be collected, along with measures of water quality such as pH, turbidity, and temperature in real-time. The collected data is carefully analyzed and distributed through a public website. By making this information available, the industry can gain a comprehensive understanding of the potential impact on air and water quality in the environment and on the chemicals used in their processes. This analysis will help them take proactive steps to reduce pollution and improve air and water quality. Furthermore, the project goes beyond industrial applications and benefits the general public. By sharing sensor data through a website, people can learn about the air and water quality in their community and take necessary steps to protect their health.

Keywords: air quality, water quality, industrial facilities, real-time mode, analysis, public awareness, environmental responsibility.

Introduction

It is becoming more and more important to find efficient and sustainable processes in the dynamic design environment. Monitoring and analyzing abiotic factors such as air quality and water use play an important role as businesses strive to reduce their environmental impact and improve production conditions. The advent of Internet of Things (IoT) technology has the potential to revolutionize real-time data collection, analysis and decision-making. This research project offers new ways to monitor abiotic conditions by focusing on air quality and water use in production. By leveraging the power of IoT, continuous monitoring of these critical points is possible, leading to improved operational efficiency, resource savings and environmental sustainability. Good monitoring of air quality in

production facilities is important. Pollutants such as pH, volatile organic compounds (VOCs) and harmful gases can affect worker health and the quality of the final product. Timely detection and reduction of these diseases is important in terms of ensuring safety and health in the workplace and compliance with the legislation. Similarly, monitoring water use is important to support sustainable production. Overuse of water not only consumes fewer resources, but also produces wastewater containing harmful substances. By constantly monitoring water use and analyzing different data, companies can identify unproductive areas, implement conservation plans, and minimize the effects of their companies operations on the environment. The IoT-based monitoring system proposed in this document includes sensor connectivity, data analytics, and cloud computing to provide real-time insight into air quality and water usage. Wireless sensors are installed throughout the factory to collect data on various parameters such as temperature, turbidity, pH level and quality indicators. This data is then transmitted to a central server or cloud platform where advanced analytical techniques are used to analyze, visualize and interpret the data. Analysis of the data collected allows companies to understand patterns, trends and relationships between air quality and water use. By using a data-driven approach to decision making, companies can improve processes, identify vulnerabilities, prevent potential problems, and make informed choices about resource allocation and protection strategies. In addition, the integration of IoT with existing manufacturing processes ensures compatibility with other process control and automation technologies, increasing efficiency and adaptability. In conclusion, this article presents a new IoT-based approach for continuous monitoring and analysis of abiotic factors in production, especially air quality and domestic water. Using the power of IoT, manufacturing companies can increase operational efficiency, improve environmental safety and comply with regulatory requirements. Insights gained through continuous monitoring and analysis pave the way for informed decision making, effective monitoring and effective resource management, ultimately leading to efficient and responsible production.

Literature Survey

In [1], Recently, environmental concerns have gotten increasing attention., prompting more search for ways to solve these problems. Extraction of data from sensor devices is a traditional approach to tackling environmental issues, which must then be stored on specialized platforms. Data transfer is also necessary to ensure that the collected data can be corrected during the audit. However, these methods are often cumbersome and ineffective. For better performance, it is necessary to combine data with data processing software. Geographic Information Systems (GIS) has become a preferred software in different sectors due to its superior performance. GIS provides a way to capture many types of data, including scanning and digitizing paper data, importing measurements based on coordinate geometry, directly importing location data, and processing remote data into raster files. GIS has emerged as a crucial tool in fields including the study of soil resources, groundwater management, and the evaluation of biomass. While GIS technologies are widely used to solve economic problems related to geographic relations, their application to environmental problems has not been explored. Therefore, this study focuses on the analysis of GIS applications in risk assessment and management in the environmental assessment process. Using the capabilities of GIS, scientists and practitioners can assess and manage environmental risks, thus making environmental research more efficient and effective.

In [2], The emergence of mobile IoT, particularly the inclusion of narrowband IoT technologies defined by 3GPP in the LTE-Advanced Release-13 standard, was fueled by the expanding interest in the Internet of Things (IoT). both at once, the serious effects of air pollution, especially fine dust and ozone, have increased the world's interest in environmental protection. While rich dust emitted mainly from the combustion of fossil fuels is known to cause or cause lung damage, O3 formed as a result of photochemical reactions involving NO2 and poor organic compounds can cause respiratory problems. Therefore, caution is needed with air quality monitoring, which can measure and identify pollutants. Although most nations have official air quality monitoring programmes, such as South Korea's NAMIS (National Ambient Air Quality Monitoring Information System), these programmes frequently utilise pricey equipment as air monitoring stations. An air monitoring system that can monitor public buildings, homes, and businesses in places without access to NAMIS infrastructure is therefore urgently needed.. This research paper presents an IoT-based cloud monitoring system that uses long-term data transmission (LTE) wireless technology to overcome cost and installation space constraints with existing weather monitoring equipment. The proposed system includes models that can measure various environmental factors, including fine dust and ozone. The measured data, along with location and status information, is sent to the LTE network where it is analyzed on the server.

In [3], To protect the health and wellbeing of construction workers, appropriate air quality must be maintained. Workers are frequently exposed to contaminants at construction sites, including volatile organic compounds (VOCs), high amounts of carbon dioxide, and excessive humidity. These pollutants can lead to respiratory conditions including asthma, silicosis, chronic lung disease, and even lung cancer. Additionally, noise from construction equipment is frequently subjected to by construction workers, which can have a negative impact on their physical and mental health, productivity, and communication. However, many nations, including Singapore, lack particular air quality standards at construction/renovation sites. The US Green Building Council has produced recommendations for indoor air quality control during construction. The utilisation of sensor technologies in several scientific fields holds considerable potential for tracking interior environmental factors including noise and air quality. Real-time monitoring and data gathering are made possible by using a smart system built on the Internet of Things (IoT) that leverages wireless connection between sensors. This research proposes an IoT-based measuring system for monitoring the interior environment, named the Environmental Monitoring Network System (EM2S), while current research mostly focuses on linked physical devices.

Problem Statement

The manufacturing industry faces significant challenges in monitoring and controlling abiotic factors, particularly air quality and water use. The routine data collection and analysis process is often time-consuming, inefficient, and lacks real efficiency. This hinders companies' ability to address issues related to air quality, employee health and resource conservation, resulting in health hazards, sanitation, environmental impact and non-compliance with regulations. In addition, the lack of continuous monitoring limits companies' ability to identify patterns, trends and vulnerabilities in air quality and water use. Without access to accurate and timely information, it is difficult to make informed decisions, implement interventions and improve business development processes.

Objective

• To develop an IoT-based monitoring system for continuous measurement and data collection of air and water use in production facilities.

• Provide data storage on a central server or cloud platform and use advanced statistical methods and data analysis techniques for storage, processing and analysis.

• It is a pity to develop analytical techniques to identify patterns, trends and anomalies in air and water use data, enabling manufacturers to make more efficient and effective decisions

• Intuitive data visualization tools that provide stakeholders with clear and actionable information about abiotic monitoring, facilitating effective communication and decision making, and create boards.

Methodology

1. Sensor Deployment:

Connect the MQ3, MQ4, MQ7, MQ8, MQ9 and MQ135 gas sensors to the Arduino Mega board to monitor air quality.

Connect the temperature sensor, turbidity sensor and pH sensor to the Arduino Mega board for water quality monitoring.

Make sure proper calibration and configuration of the sensors.

2. Data Collection:

Set up a data logging system using the Arduino Mega board to collect data from the connected sensors.

Use the Arduino programming language to read sensor data at regular intervals.

3. Data Transmission and Storage:

Connect the Arduino Mega board to a computer using the USB connector.

Develop a program or script to transfer the collected data from the Arduino Mega board to an Excel spreadsheet.

Store the data in the Excel sheet for further analysis.

4. Data Analysis:

Use data analysis tools in Excel to analyze data. Use statistical methods and appropriate techniques to identify patterns, trends, and anomalies in air and water use data. Create visualizations, charts, and graphs to present analytical data effectively.

5.Regulatory Compliance:

Ensure compliance with government standards for air and water use. Cross-reference collection of documents with administrative rules and procedures. Use warning messages or reports in the system to alert users when monitoring abiotic organisms above the usage limit. Block Diagram of the Proposed System. System Block Diagram with all components.

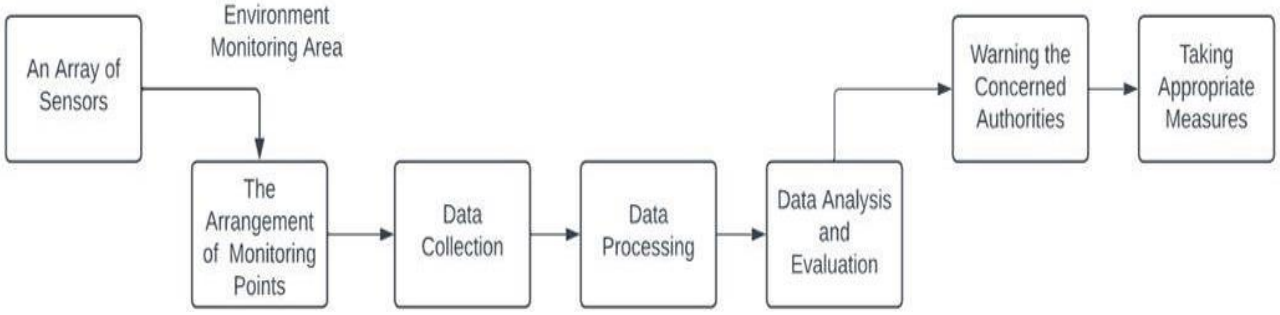

Fig. Block diagram of the proposed system

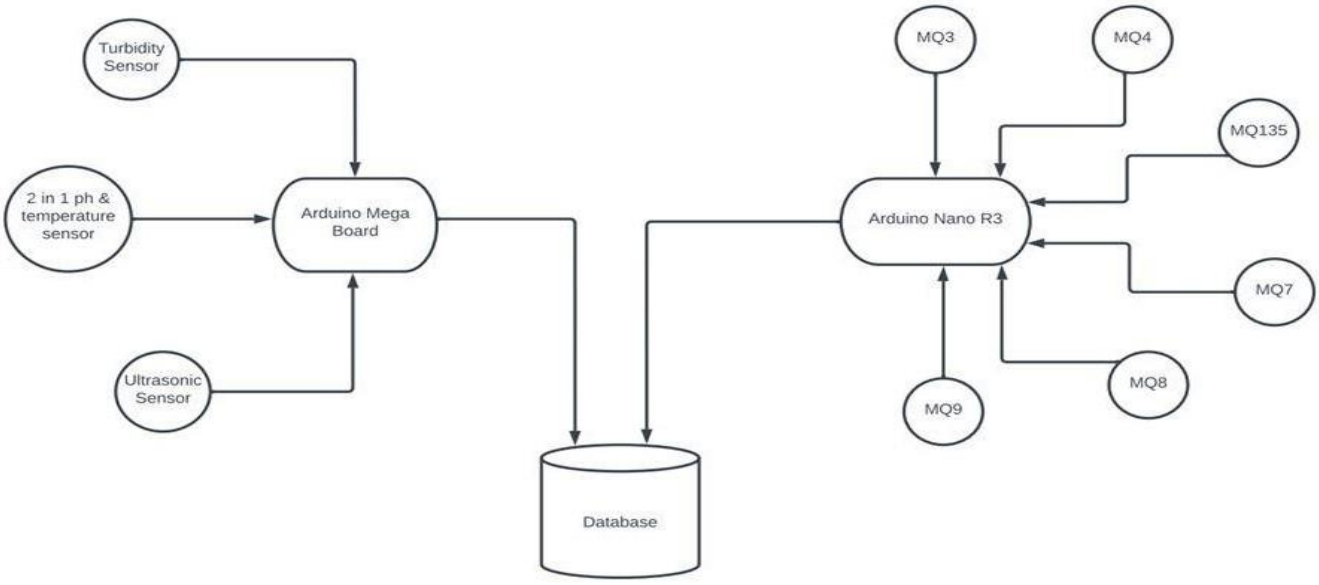

Fig. Block diagram of the proposed system with all components

Implementation And Results

The kit of the model is designed to be portable and light weight. The kit is comprised with all the sensors and a small power backup for normal use. The kit will be connected to a computer to a computer to store the data and the display on the kit will show the readings in real-time and buttons are used to toggle between readings.

Fig.3 Air sensing kit

Air kit will sense gasses in the environment using MQ series sensors and will stream the data in com port in computer we will have ms excel with data streamer so that we can receive the data that is being streamed in the com port from the kit. The Streamed data in data streamer will be in six different channels we assign channels to sensors and will start capturing the data being streamed. In ms excel we will use plot to represent the data over the time period and can easily identify the patterns in an industry.

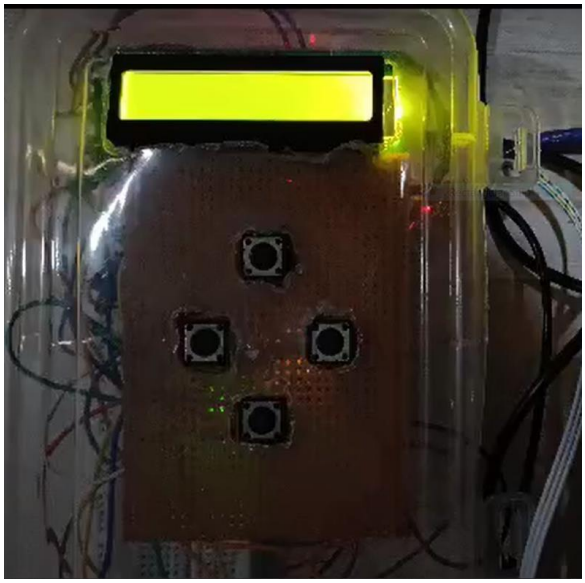

Fig.4 Water sensing kit

In water sensing kit we use temperature sensor, pH sensor, ultrasonic sensor and turbidity sensor. We can use these sensors for various purposes in industries to monitor the raw material condition this will be most effective in chemical industries and industries which use highly reactive to contamination and also have high chances of getting a low quality product due to contamination. Industries can use this kit to know their emissions into the environment and try to reduce the emissions. Public use, normal people can install this system near the locality and publish the report to the residents helping them know what they are breathing and drinking to take appropriate actions.

Hardware And Software Requirements

HARDWARE REQUIEMENTS:

- Arduino UNO Microcontroller
- Arduino MEGA Microcontroller
- MQ3, MQ4, MQ7, MQ8, MQ9, MQ135
- 16*2 LCD I2C display
- pH Sensor
- Temperature Sensor
- Turbidity Sensor
- Ultrasonic Sensor
- Mechanical buttons

SOFTWARE REQUIREMENTS:

- Arduino IDE
- MS Excel
- React JS
- HTML
- CSS

Future Scope

In future developments, there is potential to expand the application of this system to detect more elements present In environment. Additionally, the system can be further enhanced by integrating wireless data transmission and efficient power source. By continuously improving and advancing this system, Industries can benefit from enhanced monitoring and management of their materials, resulting in more efficient production and increased efficiency. The automation of the whole process will make this system more efficient and user friendly.

Conclusion

The implementation of IoT sensors enabled real-time data collection of various pollutants and water quality parameters, providing valuable insights into the environmental conditions. The collected data was analyzed and visualized, allowing for a comprehensive understanding of patterns, trends, and correlations related to air and water quality.

The proposed monitoring system offers several significant benefits. For industrial companies, it provides a means to be more aware of the quality of the air and water in their surroundings, helping them take proactive steps to reduce pollution and improve environmental conditions. By optimizing their processes and resource allocation, companies can enhance operational efficiency, mitigate risks, and ensure compliance with regulatory standards.

Moreover, the benefits of the IoT-based monitoring system extend beyond industrial use. By making the collected data available to the public, individuals in communities can become more aware of the air and water quality in their surroundings. This empowers them to take steps to protect their health and make informed decisions regarding their environment.

The integration of IoT technology, sensor networks, data analytics, and cloud computing offers a powerful and scalable solution for continuous abiotic factor monitoring. The system provides real-time insights, facilitates data-driven decision-making, and enables adaptive operations.

References

1. S. H. Kim, J. M. Jeong, M. T. Hwang and C. S. Kang, "Development of an IoT-based atmospheric environment monitoring system," 2017 International Conference on Information and Communication Technology Convergence (ICTC), Jeju, Korea (South), 2017, pp. 861-863, doi: 10.1109/ICTC.2017.8190799.
2. N. KIM et al., "Environment Monitoring Mesh System (EM2S)," 2019 IEEE 5th International Conference on Mechatronics System and Robots (ICMSR), Singapore, 2019, pp. 97-101, doi: 10.1109/ICMSR.2019.8835453.Santhosh Kumar S, Anusha M, Mohammed Junaid “IoT Based Agriculture Using Agribot”, IEEE 2019
3. Y-P. Eric Wang, X. Lin, A. Adhikary et al., "A primer on 3GPP narrowband Internet of Things", IEEE Communications Magazine, vol. 55, no. 3, pp. 117-23, March 2017.
4. T.J. Park et al., "LPW A IoT network technology trends", Electronics and Telecommunications Trends ETRI, vol. 32, no. 1, pp. 46-53, 2017
5. Ji Su Oh, Sang Hyun Park, Myoung Kwan Kwak, Chang Hae Pyo et al., "Ambient Particulate Matter and Emergency Department Visit for Chronic Obstructive Pulmonary Disease", Journal of the Korean Society of Emergency Medicine, vol. 28, no. 1, pp. 32-39, Feb. 2017.