INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)

e-ISSN : 2583-1062

Impact Factor: 5.725

www.ijprems.com
editor@ijprems.com

Vol. 04, Issue 05, May 2024, pp: 818-820

ENHANCING INDOOR AIR QUALITY THROUGH ADVANCED AIR PURIFICATION SYSTEMS

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DOI: https://www.doi.org/10.58257/IJPREMS33930

ABSTRACT

Air pollution poses a critical threat to public health and environmental sustainability, with Indian cities, notably Delhi, grappling with severe consequences. This study investigates the detrimental effects of air pollution on human health, particularly in densely populated urban areas, and explores innovative solutions utilizing the Internet of Things (IoT) for real-time air quality monitoring.

1. INTRODUCTION

The contamination of air and sound is increasing abruptly. To bring it under control, monitoring is strongly recommended. To address this issue, we are introducing a system that can detect the level of sound and the presence of harmful gases in the surroundings. The rapid increase in pollution, whether in the form of high decibel levels or toxic gases, is causing significant harm to living beings. This requires special attention to mitigate the impact on Earth's health .The proposed system is a device designed to filter the air in indoor spaces, effectively removing vapors and particles generated during metal soldering. This innovative system aims to enhance indoor air quality by eliminating solder fumes, heat, noxious odors, and other airborne particles that could have adverse health effects. Equipped with a mechanical fan, the system extracts toxic fumes, bacteria, gases, and particles through a carbon filter. A key component of this system is a smoke absorber,which plays a crucial role in removing fumes and harmful gases. Having a smoke absorber with a built-in fume extractor is particularly important in areas dedicated to industrial or mechanical tasks that produce hazardous fumes and smoke, safeguarding the health of individuals in these environments. The pollution of air often goes unnoticed. All human activities, from domestic cooking to highly mechanized industries, contribute to air pollution. Primary pollutants, such as sulfur dioxide, nitric oxides, and carbon monoxide, are emitted directly into the atmosphere. Secondary pollutants are formed through the photochemical reaction of primary pollutants.

2. LITERATURE SURVEY

Many creative measures are being done nowadays in order to get healthy air. The suggested system is based on the Arduino UNO microcontroller, which is an IoT device. The Arduino UNO is a popular and widely used microcontroller. In this article, IOT is used to gather data on temperature and humidity levels at a set interval of time, and users may utilize this information to determine the overall average temperature and humidity level for a given day. The user may use this model to not only monitor and record the temperature and humidity levels within the home, but also to determine their values outside the house. The proposed system also allows the user to monitor carbon monoxide levels within the home, which aids in being aware of the concentration of pollutants present in both indoor and outdoor air, allowing one to take appropriate action to manage it. The suggested system's most essential aspect is accurate data gathering of both outside and interior air quality. As a result, the suggested system is intended to gather accurate and efficient data for monitoring indoor air quality. Because the monitoring area changes, the device was created with an extensible interface that allows it to be readily adapted to the environment. As a result, several kinds of sensors are placed in the system to monitor both interior and outdoor air quality. A GSM modem is also included in the system, which allows gathered data to be sent immediately to the user interface or web server for air quality observation and monitoring. Microcontrollers and databases are placed in most IoT-based suggested systems to gather and send data wirelessly to the user interface and web server. The most essential goal of this suggested system is to detect air quality effectively .Air pollution is one of the most pressing issues today; the entire world is grappling with the issue of air pollution as a result of rising levels of harmful gases in the environment, which cause a slew of health issues, as well as rising levels of harmful gases in the environment and rising surface temperatures in the atmosphere, which contribute to global warming. Because people spend 80-90 percent of their time inside, such as at school, work, or at home, it is critical to have high quality air in these areas because indoor air pollution causes serious health issues such as sickness, cancer, and a variety of other ailments. The concentration of various gases and particle contaminants in indoor air determines the quality of the air. Many causes contribute to the rise of air pollution. Humidity and high temperatures may also raise the concentration of some contaminants in indoor fresh air. Ventilation and air filtration may be used to manage indoor air pollution sources.

The main ways of obtaining high quality air in buildings, workplaces, and any other indoor establishments are ventilation and air filtration

3. HARDWARE AND SOFTWARE

REQUIREMENTS

3.1 HARDWARE REQUIREMENTS:

1. Air Quality Sensors:
- PM sensors
- CO2 sensors
- CO sensors
- VOC sensors
- Other pollutant-specific sensors
2. Raspberry Pi Zero:
- Central control unit for data processing and system management.
3. Arduino Boards:
- Microcontroller platforms for sensor interfacing and data acquisition.
4. Air Purifier:
- Device for improving indoor air quality by removing pollutants.
5. Communication Devices:
- WiFi or Ethernet modules for connectivity.
- GSM modules for SMS alerts (optional).
6. Power Supply:
- Power adapters or batteries to supply electricity to the devices.

3.2 SOFTWARE REQUIREMENTS:

1. Node.js, Express.js
2. MongoDB, MySQL, PostgreSQL
3. MQTT Broker: Mosquitto, HiveMQ
4. IoT Data Processing
5. Python, JavaScript
6. Real-Time Communication
7. MQTT Protocol
8. WebSocket
9. Web Application
10. React.js, Angular, Vue.js
11. Node.js, Express.js
12. Mobile Application
13. React Native, Flutter, NativeScript
14. Database Management
15. MongoDB, MySQL, PostgreSQL
16. User Authentication and Authorization
17. JWT (JSON Web Tokens)
18. Role-based access control (RBAC)
19. Data Visualization
20. Chart.js, D3.js, Leaflet.js
21. Security Measures
22. SSL/TLS
23. Helmet.js
24. Deployment and DevOps
25. Docker, Kubernetes
26. Jenkins, GitLab CI/CD

4. CONCLUSION

In conclusion, urgent action is needed to address air pollution in urban areas like Delhi, India. Traditional monitoring methods are insufficient, prompting the proposal of innovative IoT solutions. Leveraging Arduino boards and IoT platforms for real-time monitoring, coupled with the WoT framework, offers promising avenues for tackling indoor air quality issues

ACKNOWLEDGEMENT

Our venture facilitator, Mrs.Mamatha poreddy, and our aide, Mrs. P. Swaroopa, have been exceptionally useful in the meantime, and we are extremely thankful to them. My most profound appreciation additionally goes out to Dr. M.V. Vijaya Saradhi, Top of the Software engineering and Designing Division and the Web of Things (CSE) at Expert Designing School, for the entirety of the assistance and time he has given me.

5. FUTURE IMPROVEMENTS

1. Advanced Filtration Technologies: Continued research and development in filtration technologies will lead to the creation of more efficient filters capable of capturing even smaller particles, including ultrafine particles and nanoparticles.

2. Smart Sensors and Monitoring Systems: The integration of smart sensors and monitoring systems into indoor air quality management solutions will enable real-time monitoring, data analysis, and feedback mechanisms for better control and optimization of indoor environments.

3. Integration of Artificial Intelligence (AI): AI algorithms can analyze vast amounts of data from indoor air quality sensors and other sources to identify patterns, predict air quality trends, and optimize HVAC systems for improved energy efficiency and air quality.

4. Personalized Air Quality Solutions: Advances in wearable technology and personalized health monitoring will allow individuals to track their exposure to indoor pollutants and receive personalized recommendations for improving indoor air quality based on their specific needs and preferences.

6. REFERENCES

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[2] 2. "Principles of Heating, Ventilating, and Air Conditioning: A Textbook with Design Data Based on the 2017 ASHRAE Handbook—Fundamentals" by Ronald H. Howell and C. David Yuill: This textbook provides foundational knowledge on HVAC systems, ventilation, air distribution, and air quality control, which are essential for understanding indoor air quality management.

[3] 3. "Indoor Environmental Quality" by Thad Godish and H.E. Burroughs: This book offers insights into indoor environmental squality (IEQ) factors beyond air quality, such as thermal comfort, lighting, and acoustics, providing a holistic approach to creating healthy indoor environments.

[4] 4. "Sustainable Design of Research Laboratories: Planning, Design, and Operation" by Bungale S. Taranath: While focused on laboratory design, this book covers topics relevant to indoor air quality, such as ventilation systems, filtration, and contaminant control strategies applicable to various indoor settings.

[5] 5. "The Indoor Environment Handbook: How to Make Buildings Healthy and Comfortable" by Philomena M. Bluyssen: This handbook provides practical guidance on optimizing the indoor environment for health and comfort, including ventilation strategies, indoor pollutant control, and thermal comfort considerations.

[6] "HVAC Systems and Indoor Air Quality" by Yuguo Li and Dennis K. S. Lee: This book explores the relationship between HVAC systems and indoor air quality, covering topics such as filtration, ventilation rates, energy efficiency, and pollutant removal techniques.

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[8] "Healthy Buildings: How Indoor Spaces Drive Performance and Productivity" by Joseph G. Allen and John D. Macomber: Focusing on the intersection of indoor environmental quality and occupant health, this book explores the impact of indoor air quality, lighting, and other factors on human performance and productivity.