**Utilization of Particulate, Temperature and Humidity Sensor for Indoor Air Quality Monitoring in Home**

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**Literature Review**

**Market Search**

1. Formulate the research and development question(s)

* How can we enhance indoor air quality monitoring?
* What role do particulate matter, temperature, and humidity play in assessing air quality?
* How can air quality monitoring prompt the user to act to activate air purifier appliances?
* How will sensor data be displayed in LCD Display?
* What are the benefits of having an air quality monitoring device?
* What are the key factors affecting indoor air quality?
* How can we design an effective sensor system to monitor these factors?
* What improvements can be made over existing air quality monitoring solutions?

1. Establish context for your work by showing what has been done within the market.

Indoor air quality (IAQ) can have a big impact on people's comfort, productivity, safety, and health because most people spend a lot of time indoors (Jiang et al., 2013). At home, various indoor air pollutants, such as particulate matter (PM)2.5 and (PM)10, can be released during routine household tasks like cooking and cleaning (Son, 2023, as cited in Xiang et al., 2021). Unseen air pollution is a huge risk for people who has heart disease, stroke, chronic respiratory and pulmonary disease, asthma, and lung cancer. In this case, there are several studies about the applications of indoor air quality monitoring devices. For example, a development of low-cost air sensor device at the Albany Middle School, San Francisco, California that was used to detect distant wildfire (Kaduwela et al., 2019).

Aside from the studies that have a specific target market like hospitals, schools and residential buildings, there are vast amount of indoor air quality monitoring devices on the market that can be utilized for homes. Some of the reputable brands are Temtop, ATMO, Davis Instruments, and Sensirion. These companies offer different solutions for both consumers and businesses. Starting from portable indoor hand-held devices up to outdoor environmental air quality sensors.

Links for these companies are as follows:

* [Temtop Air Quality Monitoring Solutions - Your Experts in Air Quality (temtopus.com)](https://temtopus.com/)
* [ATMO – Air Quality Monitors for Consumers and Businesses (atmotube.com)](https://atmotube.com/)
* [Davis Instruments](https://www.davisinstruments.com/)
* [Home (sensirion.com)](https://sensirion.com/)

Given the examples, there are few articles about the integration of air quality sensors specifically using temperature, humidity, and particulate sensor for indoor air quality (IAQ) monitoring that will be utilized at home. In addition, the devices ready on the market don’t have either notification alert to the user or do not have integration to control other air purifying devices so solve the indoor air pollution. Consumers may have distinct requirements that are not fully addressed by these mainstream products or services.

1. Our project will be modified based on potential niche markets:
2. Consumers
3. Allergy Sufferers: Individual with sensitivities to indoor and outdoor pollutants
4. Health-conscious homeowners: Those who prioritize their health and well-being.
5. Eco-friendly homeowners: Those who prioritize sustainability and energy saving solutions.
6. Customization
7. Allergy Sufferers: Design sensor to specifically detect common allergens such as pollen, dust mites, and pet dander. Provide real-time alerts to users when allergen levels exceed thresholds.
8. Health-conscious homeowners: Sensor contributes to a healthier living environment by monitoring indoor air pollutants and providing alerts.
9. Eco-friendly homeowners: Highlight its low energy consumption, recyclable materials, and sustainable manufacturing process.
10. Is there a limitation or constraint that you can address to increase the attractiveness of your product?

Upgradability and Modularity: Many low-cost indoor air quality monitoring devices are standalone units, requiring users to purchase additional products to install in other areas of the home. Address this by making the project ready for integration with other sensors or mesh system, preparing the project to control other health-related products such as air purifiers and humidifiers, and providing a hardware design that is easy to install and maintain.

1. Expose the gap within current products in meeting the "need" or solving the "problem".

Current products in the market often lack comprehensive solutions to address the need for effective indoor air quality monitoring and management. While some devices may offer basic monitoring capabilities, they often fall short in several key areas:

1. Lack of Integration: Many existing products do not offer integration with other smart home devices such as air purifiers, limiting their ability to provide a holistic solution for improving indoor air quality.
2. Limited Automation: Current devices may not provide automated alerts or actions to prompt users to take measures when air quality deteriorates, leaving users unaware of potential issues or requiring manual intervention.
3. Inaccuracy: Some devices may suffer from inaccuracies or inconsistencies in sensor readings, leading to unreliable data and potentially incorrect interpretations of indoor air quality conditions.
4. Complexity: Certain products may be overly complex to use, with convoluted interfaces or unclear instructions, making it challenging for users to understand and interpret the data provided.
5. Lack of Customization: Many devices offer limited customization options, failing to cater to the diverse needs and preferences of different users, such as allergy sufferers or eco-conscious individuals.

Our proposed product addresses these gaps by offering a more comprehensive and effective solution:

1. Integration and Automation: Our device seamlessly integrates with other smart home devices, such as air purifiers, and provides automated alerts and actions to ensure timely responses to changes in indoor air quality.
2. Enhanced Accuracy: Utilizing advanced sensor technology, our product delivers more accurate and reliable measurements of particulate matter, temperature, and humidity, enabling users to make informed decisions and take appropriate actions.
3. Simplified User Experience: We prioritize user-friendliness, designing an intuitive interface and clear display to make it easy for users to understand and interpret the data presented by the device.
4. Customization Options: Our product offers extensive customization features, allowing users to tailor settings and alerts based on their specific needs and preferences, catering to a diverse range of users, including allergy sufferers and eco-conscious individuals.
5. Refine your "answer" to the "problem".

Our proposed indoor air quality monitoring device offers a comprehensive solution to address the shortcomings of existing products. By seamlessly integrating with other smart home devices and providing automated alerts and actions, our product ensures timely responses to changes in indoor air quality, thus enhancing user convenience and peace of mind.

Utilizing advanced sensor technology, our device delivers accurate and reliable measurements of particulate matter, temperature, and humidity, empowering users to make informed decisions and take proactive steps to improve their indoor environment.

We prioritize user-friendliness, designing an intuitive interface and clear display that make it easy for users to interpret and act upon the data presented by the device. Additionally, our product offers extensive customization options, catering to the diverse needs and preferences of different users, including allergy sufferers and eco-conscious individuals.

In summary, our indoor air quality monitoring device provides a superior solution by addressing the limitations of current products and offering enhanced functionality, accuracy, and user experience.

**Technology Reuse**

**GitHub Links**

[**https://github.com/adafruit/DHT-sensor-library.git**](https://github.com/adafruit/DHT-sensor-library.git)

[**https://github.com/particle-iot/docs.git**](https://github.com/particle-iot/docs.git)

[**https://github.com/koenvervloesem/ESPHome-Air-Quality-Monitor.git**](https://github.com/koenvervloesem/ESPHome-Air-Quality-Monitor.git)

[**https://github.com/bastienwirtz/air-quality-monitor.git**](https://github.com/bastienwirtz/air-quality-monitor.git)

[**https://github.com/SmejkalJakub/bcf-room-air-quality-monitor.git**](https://github.com/SmejkalJakub/bcf-room-air-quality-monitor.git)

[**https://github.com/randombenj/air-quality-monitoring.git**](https://github.com/randombenj/air-quality-monitoring.git)

[**https://github.com/jsynowiec/airqmon.git**](https://github.com/jsynowiec/airqmon.git)

[**https://github.com/Community-Sensor-Lab/Air-Quality-Sensor.git**](https://github.com/Community-Sensor-Lab/Air-Quality-Sensor.git)

[**https://github.com/evanxd/air-quality-monitoring-station.git**](https://github.com/evanxd/air-quality-monitoring-station.git)

[**https://github.com/CedarGroveStudios/CircuitPython\_AirQualityTools.git**](https://github.com/CedarGroveStudios/CircuitPython_AirQualityTools.git)

[**https://github.com/IEA-EBC-Annex86/annex.git**](https://github.com/IEA-EBC-Annex86/annex.git)

[**https://github.com/GHF/iaq-node.git**](https://github.com/GHF/iaq-node.git)

**YouTube Links**

[**https://youtu.be/gyEXT2BwaRs?si=gLQpFmoDy7\_MonEm**](https://youtu.be/gyEXT2BwaRs?si=gLQpFmoDy7_MonEm)

[**https://youtu.be/M\_vLRSQWIhE?si=PjIbTkNyYbKPBdmC**](https://youtu.be/M_vLRSQWIhE?si=PjIbTkNyYbKPBdmC)

[**https://youtu.be/esY\_OtDLv7g?si=yq47Op-6rZMoYLUb**](https://youtu.be/esY_OtDLv7g?si=yq47Op-6rZMoYLUb)

[**https://youtu.be/GF27dp4RA0g?si=gGiUbYrx7ot8NRxs**](https://youtu.be/GF27dp4RA0g?si=gGiUbYrx7ot8NRxs)

[**https://youtu.be/OCsmMD4wtNQ?si=7M4djBx6VPwnBz-E**](https://youtu.be/OCsmMD4wtNQ?si=7M4djBx6VPwnBz-E)

[**https://youtu.be/kcMzBV3XW2E?si=H2\_gVjhe5GdzDn0v**](https://youtu.be/kcMzBV3XW2E?si=H2_gVjhe5GdzDn0v)

# **Bibliography**

Jiang, Y., Li, K., Piedrahita, R., Xiang, Y., Tian, L., Mansata, O., Lv, Q., Dick, R. P., Hannigan, M., & Shang, L. (2013). User‐Centric Indoor Air‐Quality Monitoring on Mobile Devices. *The AI Magazine*, *34*(2), 11–30. https://doi.org/10.1609/aimag.v34i2.2472

Xiang, J., Hao, J., Austin, E., Shirai, J., & Seto, E. (2021). Residential cooking-related PM2. 5: Spatial-temporal variations under various intervention scenarios. Building and Environment, 201, 108002.

Son, Y. J., Pope, Z. C., & Pantelic, J. (2023). Perceived air quality and satisfaction during implementation of an automated indoor air quality monitoring and control system. Building and Environment, 243, 110713-. <https://doi.org/10.1016/j.buildenv.2023.110713>

Kaduwela, A. P., Kaduwela, A. P., Jrade, E., Brusseau, M., Morris, S., Morris, J., & Risk, V. (2019). Development of a low-cost air sensor package and indoor air quality monitoring in a California middle school: Detection of a distant wildfire. Journal of the Air & Waste Management Association (1995), 69(9), 1015–1022. <https://doi.org/10.1080/10962247.2019.1629362>