

Breathe Smarter: Unlocking Intelligent Indoor Air Insights Using a Smart IoT Indoor Air Quality Monitor

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Individuals spend approximately 90% of their time indoors, so maintaining a good Indoor Air Quality (IAQ) is important. Fine particulate matter (PM_{2.5}) is an essential component of IAQ, as these tiny particles can remain suspended in air and affect the respiratory system. Indoor PM_{2.5} levels can vary based on ventilation, indoor occupant activities, or Relative Humidity levels. This study investigated the relationship and variations in indoor PM_{2.5} and Relative Humidity in a residential setting at a constant temperature during different timings of the day. It also evaluated whether maintaining an indoor humidity between 40-45% using an ultrasonic humidifier reduces PM_{2.5} concentrations. Professional air monitors are expensive, which limits residential studies. This highlights the need for reliable, low-cost monitoring systems. A self-built Indoor Air Quality monitoring system was used to collect data over five days at 6:00 AM, 4:00 PM, and 9:00 PM. Data analysis showed that there were significant variations in Relative Humidity at a constant temperature during different timings of the day ($p\text{-value} < 0.05$), whereas, PM_{2.5} showed no significant difference ($p\text{-value} > 0.05$). A Pearson Correlation test revealed a weak relationship between humidity and PM_{2.5}. When the same tests were repeated using an ultrasonic humidifier at 9:00 PM, reported PM_{2.5} values increased significantly from a mean of 49.88 to 133.68 micrograms per cubic meter ($p\text{-value} < 0.0001$). The increase occurred without visible haze, suggesting optical interference from suspended water droplets rather than true particulate pollution. These findings highlight limitations of consumer-grade optical PM sensors and emphasize careful interpretation of indoor air quality measurements under humid conditions.

Awards Won:

Fourth Award of \$600