Evaluating Environmental Air Pollution Effects on IAQ and Occupant Comfort through IoT Sensors and Surveys

Australians face exposure to air pollution from natural sources like bushfire smoke and dust storms, as well as human-made sources such as hazard-reduction burnings, emissions from burning fossil fuels, and traffic-related air pollution. In this study, we tried to investigate the impact of two of them: (1) hazard-reduction burnings and (2) proximity to a high-traffic road on indoor air quality (IAQ).

Why the study:

- We spend nearly 90% of our time indoors.
- Buildings are supposed to protect their occupants and decrease the penetration of outdoor air pollution indoors.
- Public buildings and educational university campus buildings have high occupancy rate and long exposure time.

What we did:

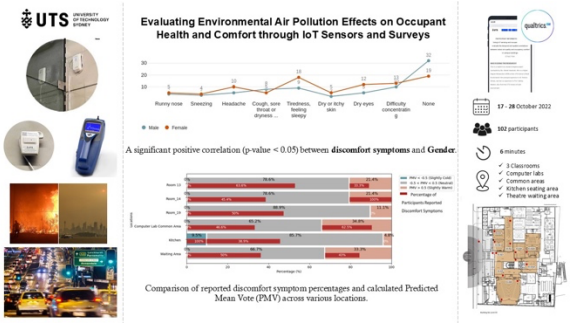
- Over 2 years, we used a UTS campus building as a test case. During that period, Sydney experienced significant air quality issues due to HRB, Winter air pollution impacts caused by the colder and drier air trapping more pollution, and daily traffic congestion. Multiple indoor and outdoor sensors were deployed across 3 levels of the building. The data collected and analyzed to answer the two below questions:
    - How do the outdoor environmental pollution levels impact the IAQ and occupants' exposure during Hazard-Reduction Burnings?
    - What are the correlations between IAQ and the health and comfort of occupants in buildings near high-traffic roads?

What we found:

- Negative correlation between floor height and distance to entrance with E-Index and the I/O ratio of PM2.5.
- Indoor levels of PM2.5 might even surpass the local EAP levels.
- Critical factors affecting PM2.5 concentrations in building spaces were: (1) humidity, (2) architectural design and (3) proximity to traffic.
- Discomfort symptoms are correlated with: (1) duration of occupancy, (2) time of the day, (3) gender, and (4) occupants' perception of "air pollution" and "air freshness".
- Subjective and objective "temperature" measurements are aligned.
- Higher discomfort in less polluted areas points to complex internal factors.

What this means:

- The significance of local indoor/outdoor sensing.
- Limitations of mechanical ventilation during severe air pollution episodes such as HRB.
- Using portable IoT-based sensors to monitor microenvironments represents a significant advancement in our ability to study IAQ.
- Thermal comfort models may not fully meet the thermal comfort needs of individuals, particularly females.



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