

Project Title: Measurement of CO₂ level, viral load, and adjusting fresh air intake depending on air quality in indoor spaces

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Targeted Need:

With people spending a large part of their lives in indoor spaces, whether it is in offices, classrooms, or homes, there is an urgent need to improve air quality in indoor environments. This issue has attracted a lot of attention in the last decade or so, and now with growing evidence that Covid-19 infection is airborne and spreads more easily in indoor spaces, a greater attention needs to be paid to indoor air quality (IAQ). In most heating, ventilation, and air conditioning (HVAC) systems, carbon dioxide (CO₂) levels are used to control ventilation rates via demand controlled ventilation (DCV). This is traditionally for addressing issues related to odour and occupant-generated bioeffluents, and providing acceptable indoor air quality for most occupants. The CO₂ level could act as a good proxy for airborne transmission risk of Covid-19 in indoor spaces. The viral load measurement would further aid in understanding the airborne transmission pathway.

Methodology and Expected Outcome:

The primary objective of this project will be to demonstrate a functioning system for automatically controlling the ventilation rate of the HVAC system based on the measured CO₂ level in an air handling unit (AHU) of the lecture hall complex (LHC). The key steps in achieving this objective are as follows:

- Understand the working of the HVAC system in LHC and identify one AHU with one or two classrooms for this project.
- Study the identified AHU along with the existing sensors, controllers, actuators, control algorithms etc.
- Repair and maintenance of the AHU components and calibration of sensors which are not functioning, and installing additional sensors and controllers (if required).
- Modification of the control logic/algorithm to meet the targeted need described above.
- Testing and demonstration of the system for automatically controlling the ventilation rate based on the measured CO₂ level.
- Deployment of wireless sensors for measuring IAQ in different parts of the service zone of the AHU.

The secondary objective of this project is to understand how the Covid-19 infection spreads in an indoor space. The key steps in achieving this objective are as follows:

- Understand the workflow of how an air sampler collects air from a space having infected individuals to RT-PCR testing for finding the viral load.
- Conduct experiments to understand the effect of ventilation (CO₂ level), air temperature, humidity, masks, space type on spread of Covid-19.

Requirements:

Access to the HVAC system in the LHC, the building management system (BMS) software, access to one AHU and the rooms serviced by this AHU along with all the AHU components, sensors, controllers, actuators, control algorithms. In addition, we would need active support and cooperation from the personnel who maintain and operate the different parts of the HVAC system and the AHU in the LHC on the IIT Delhi campus.

Access to spaces susceptible to Covid-19 infection for conducting experiments with air samplers. The air sampler will be procured through the project on composite air purification system (CAPS) and used for this project as well.

Funding Request:

Project duration = 6 months

Budget Head	Amount	Justification
Salary	Rs 3.90 lakhs	One research staff and one student for 6 months
Consumables	Rs 2.20 lakhs	Sensor replacement or for installing additional wireless sensors, PPE kits, RT PCR tests for air samples
Contingency	Rs 1.20 lakhs	
Institute Overhead (20%)	Rs 1.46 lakhs	

Total budget = Rs 8.76 lakhs