Evaluation of Alternative Sensors to Minimize HVAC Energy Use in BU Buildings and Ensure Indoor Air Quality

Vladimir Pyltsov (Mechanical Eng.)

Jakub Zolkos, Mertcan Cokbas (Electr. & Comp. Eng.)

**Professor Gevelber (Mechanical Eng.)**

Professor Konrad (Electr. & Comp. Eng.)

Motivation and Goal

▶ To reduce HVAC energy waste, air flow should scale with number of people in room. Many rooms operated at part load but without adjustment (either on or off). Occupancy varies throughout the day & season. Air is expensive both in terms of energy, GHG emissions, and cost (~$4.00/cfm/year and rooms use 1000's of cfms).

▶ Focus of this project: demonstrate capabilities for large rooms (auditoriums, meeting rooms, classrooms, open office areas)

▶ Current technology used today: CO_2 sensors based on ASHRAE 62.1 Demand Control Ventilation standard. Seek to compare achievable performance between camera's and CO2 sensors.

▶ Spring 2022 goals:

  ▶ Research, procure, install, debug CO2 sensing system

  ▶ Configure camera system

  ▶ Run a pilot test in PHO117 (2,000 ft²) - more testing in Summer & Fall 2022

CO2 Sensor System

- ▶ 3 Gaslab CU-1106H high-accuracy (+/-30 ppm), temperature-compensated sensors

- ▶ 3 locations: supply vent, exhaust vent, wall

- ▶ Objective: compare CO_2 measurement at wall with return exhaust: identify limitations. Will examine other areas throughout the room

- ▶ Sensors connected to a small networked Windows PC (in the ceiling) for data logging

Entrance

★ - location of the sensor
■ - exhaust   ⊠ - supply

Exit
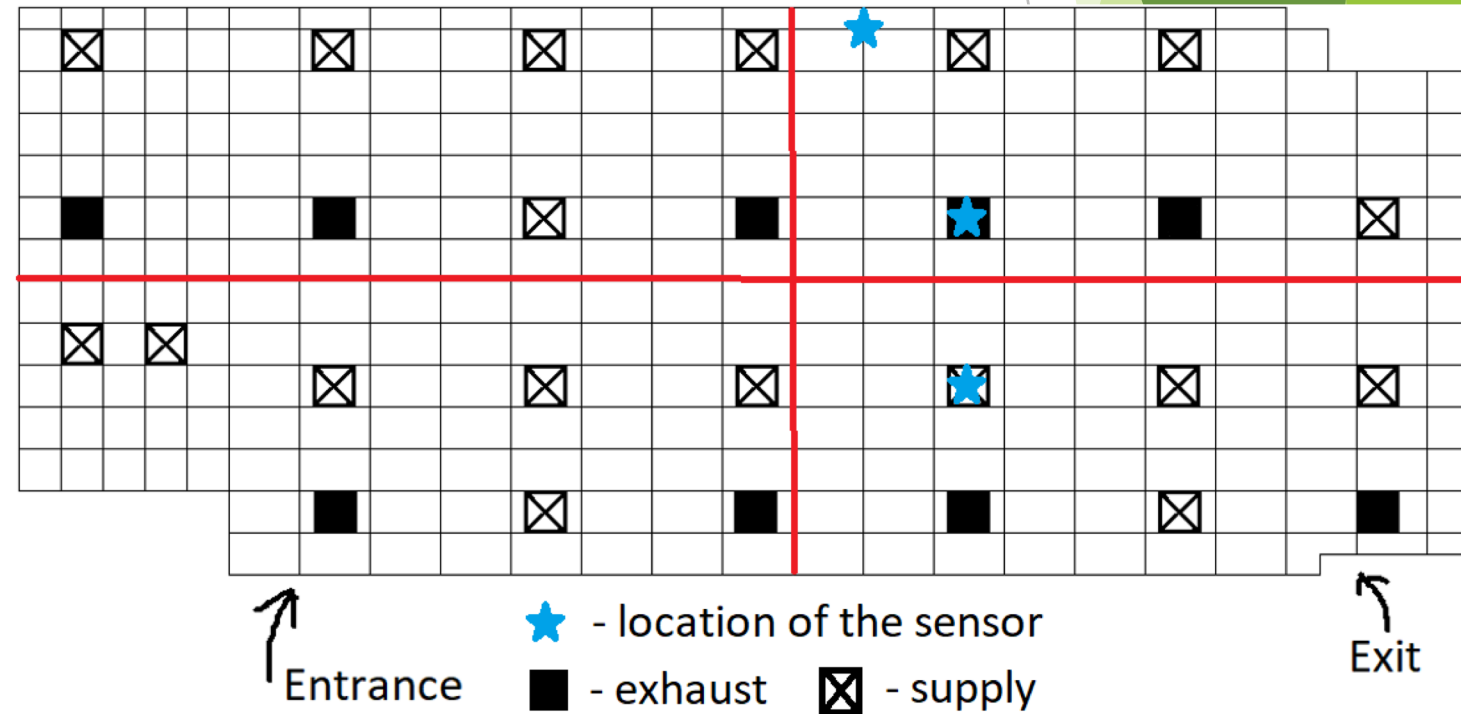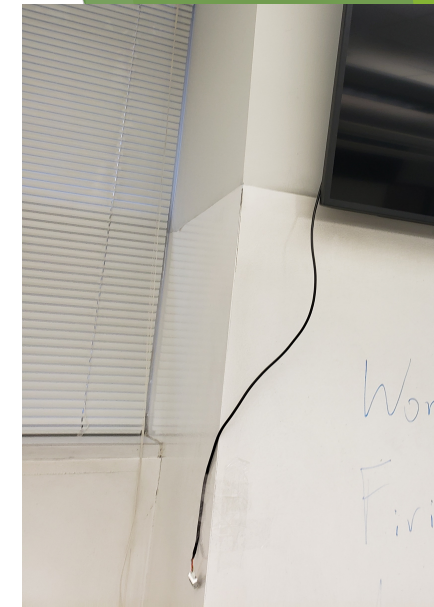
Camera System

- ▶ 3 Axis M3057-PLVE ceiling-mounted fisheye cameras

- ▶ Linux PC (I7 CPU, 16GB RAM)

- ▶ AI algorithm (RAPiD) finds people in cameras 2 & 3, and intelligently combines results without over-counting
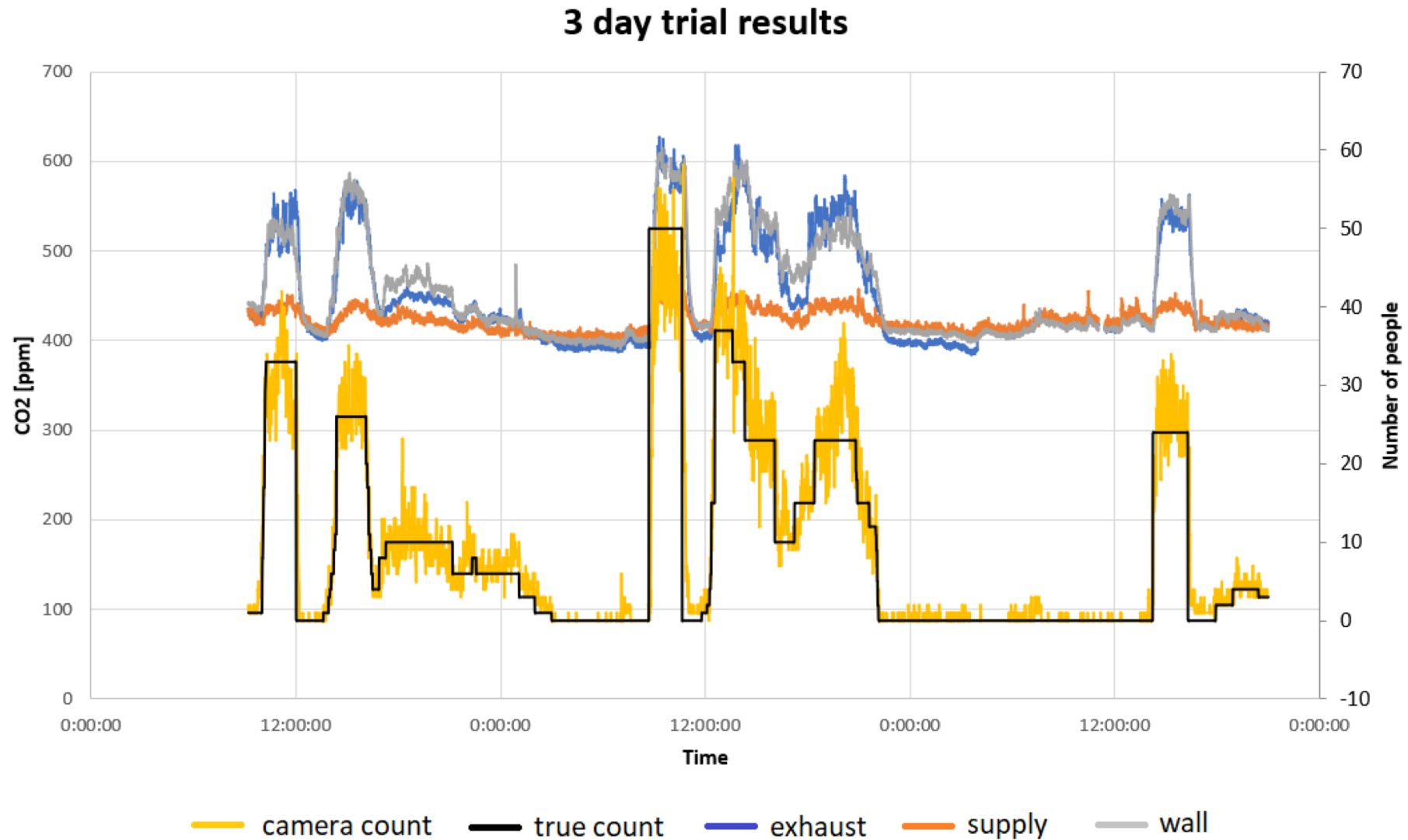
- ▶ Counts delivered each 5 sec

Results

- ▶ 3-day trial in PHO117 (2,000 ft^2)

- ▶ CO2 level and people counts compared in single plot

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Camera 2   Camera 1   Camera 3
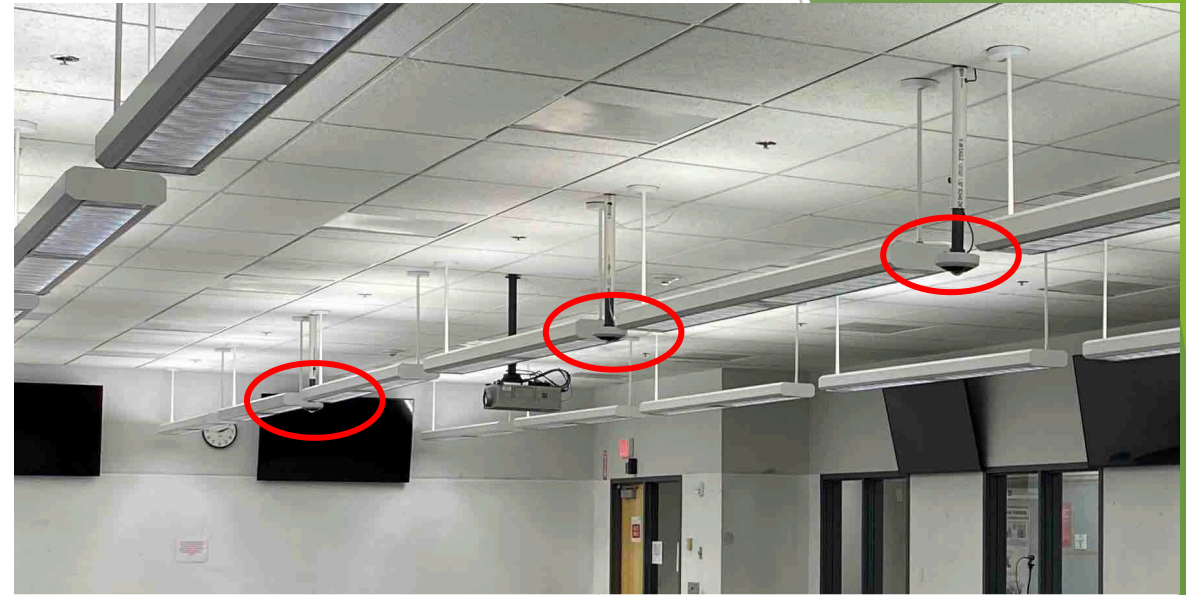
0.0   0.2   0.4   0.6   0.8   1.0
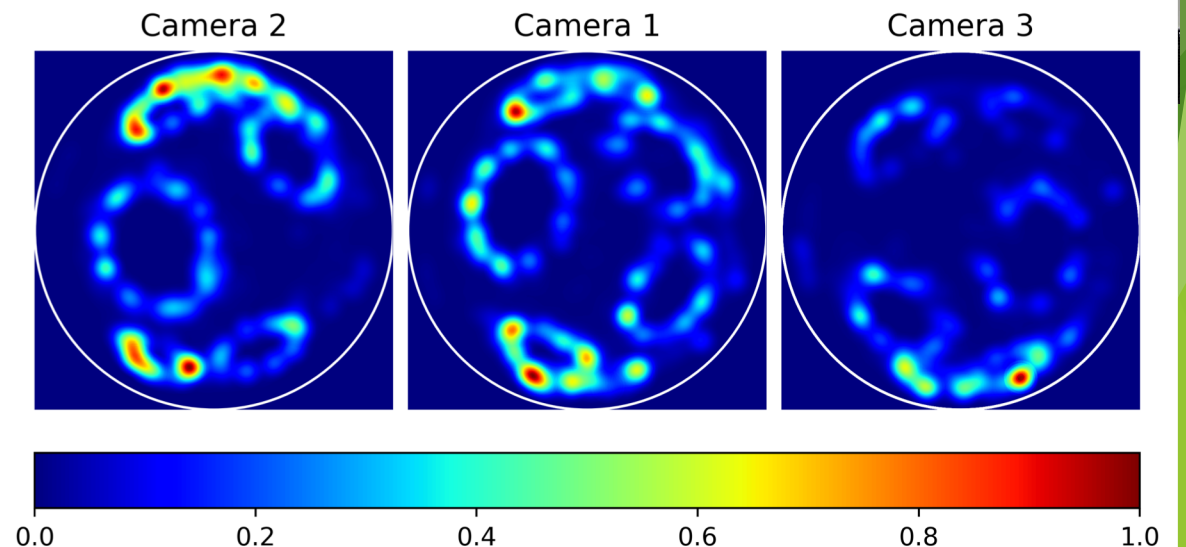
3-Day Trial Results

3 day trial results

Conclusions

- CO2 sensor system procured, installed, debugged, tested
- Camera system configured and working well
- Successful data collection and comparison
- Fall 2022 continuation:
  - Develop algorithm to estimate people count from CO2 level
  - Need to consider dynamics of room airflow/mixing. Need to consider the spatial distribution of CO_2 and where sense in the room.
  - Compare people-counts from CO2 and camera systems

Thank you!