



Wireless Temperature Sensor Network

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Background

Temperature throughout the entire building is managed through one central HVAC system.

- Goal is to keep every room at a constant temperature
- As the seasons change, the HVAC system needs to be manually adjusted

Heating
Ventilation
Air
Conditioning





Background

Customers:

- CEA Student Body
- Professors
- Staff
- Guests
 - Corporate Representatives
 - Collegiate Representatives
 - Sponsors (\$\$\$)
 - Family
 - Friends

Needs/Demands of the customers:

- Comfortable temperature of classrooms/offices
- Constant temperature between rooms
- Appropriate Adjustment of HVAC system relative to the current season
- Efficient temperature management throughout the day

Problem Formulation

The temperature within rooms of Lewis K. Downing are being managed inefficiently.

- Temperature is NOT consistent between rooms
- Different rooms serve different purposes
- Temperature is not kept consistent within one room

These factors affect the overall comfortability of all personnel within the building.

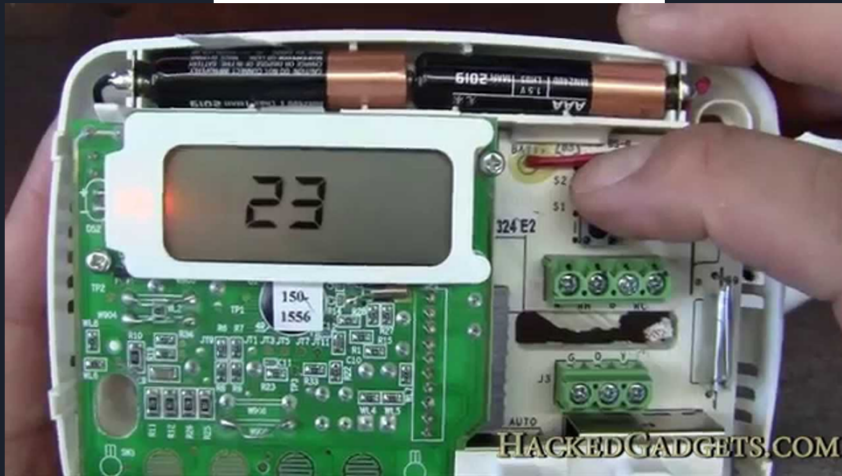


Problem Formulation



From an engineering standpoint:

- No processing power is being used to manage the temperature between rooms.
 - Also between different areas in one room
- Most active temperature sensors are built into the HVAC system itself
 - Does not measure the temp in each room accurately, in real time
- Electricity usage and HVAC usage is not recorded accurately





Problem Statement

Currently, the temperature management system within the Lewis K. Downing building through the use of a commercial HVAC is inaccurate and inefficient, raising a need for a customized, hybrid HVAC system which can sense and adjust the temperature in each room separately in real time.

Design Requirements

- Implement performance diagnostics to check the operation of the system periodically
- Offer rerouting capabilities if a node malfunctions
- Offer encryption/decryption algorithms for security purposes

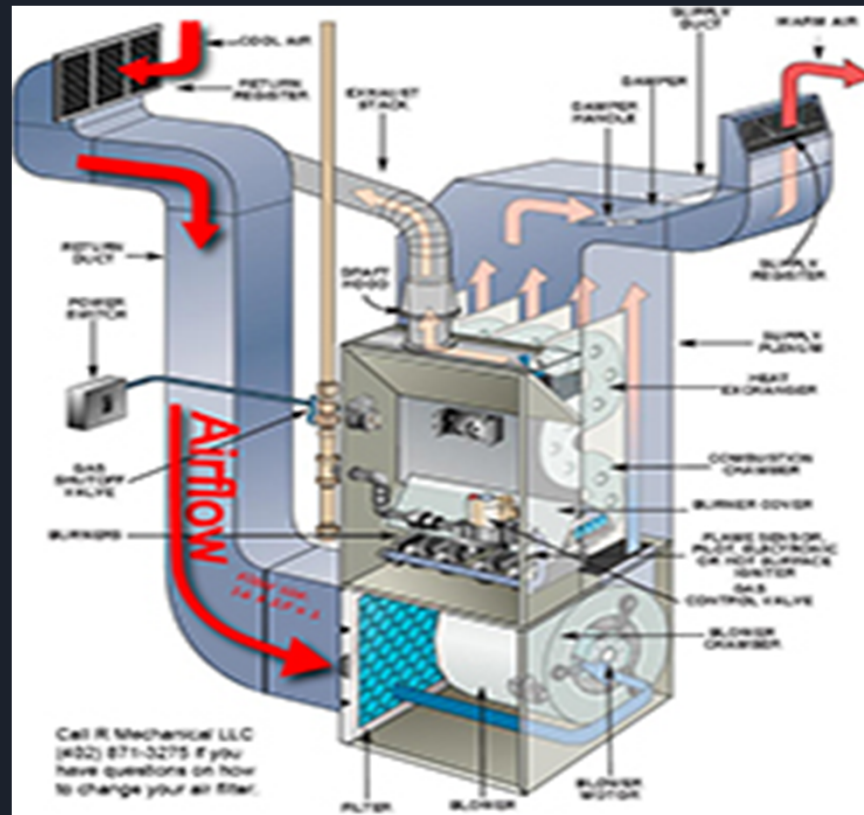
Energy/Power:

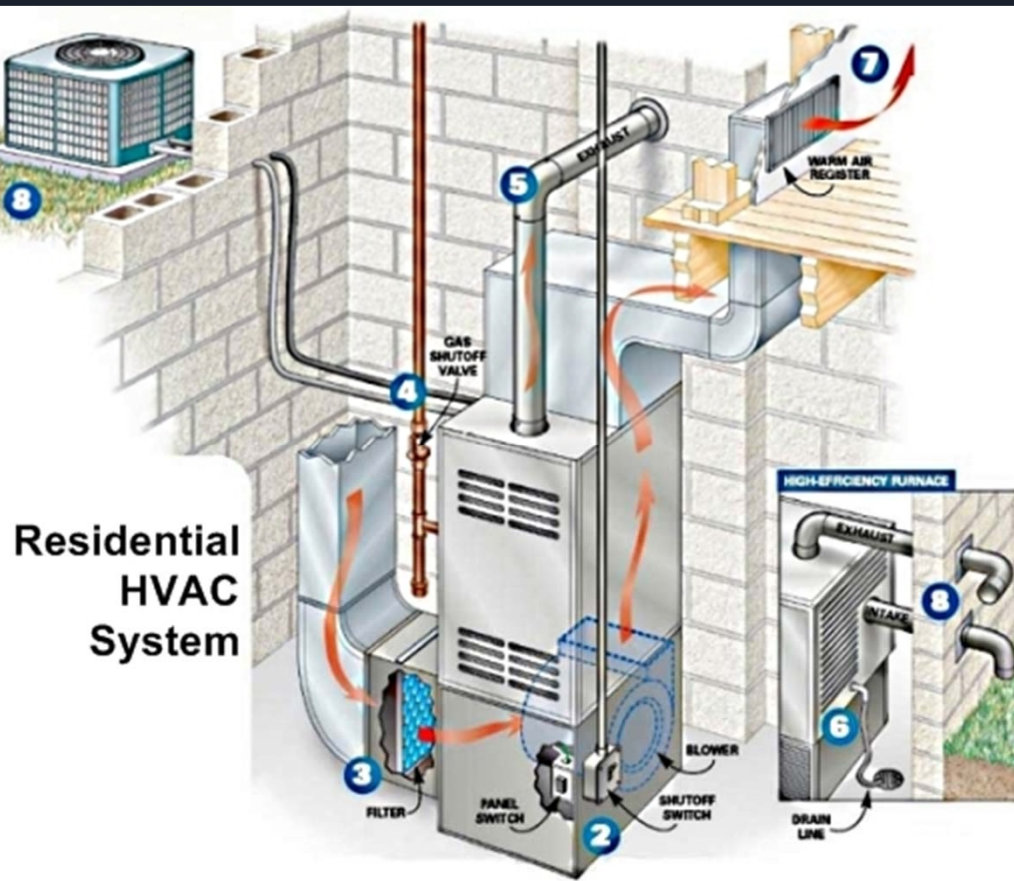
- Should meet the SAE Standard J1455 regulations regarding environmental practices for electronic equipment

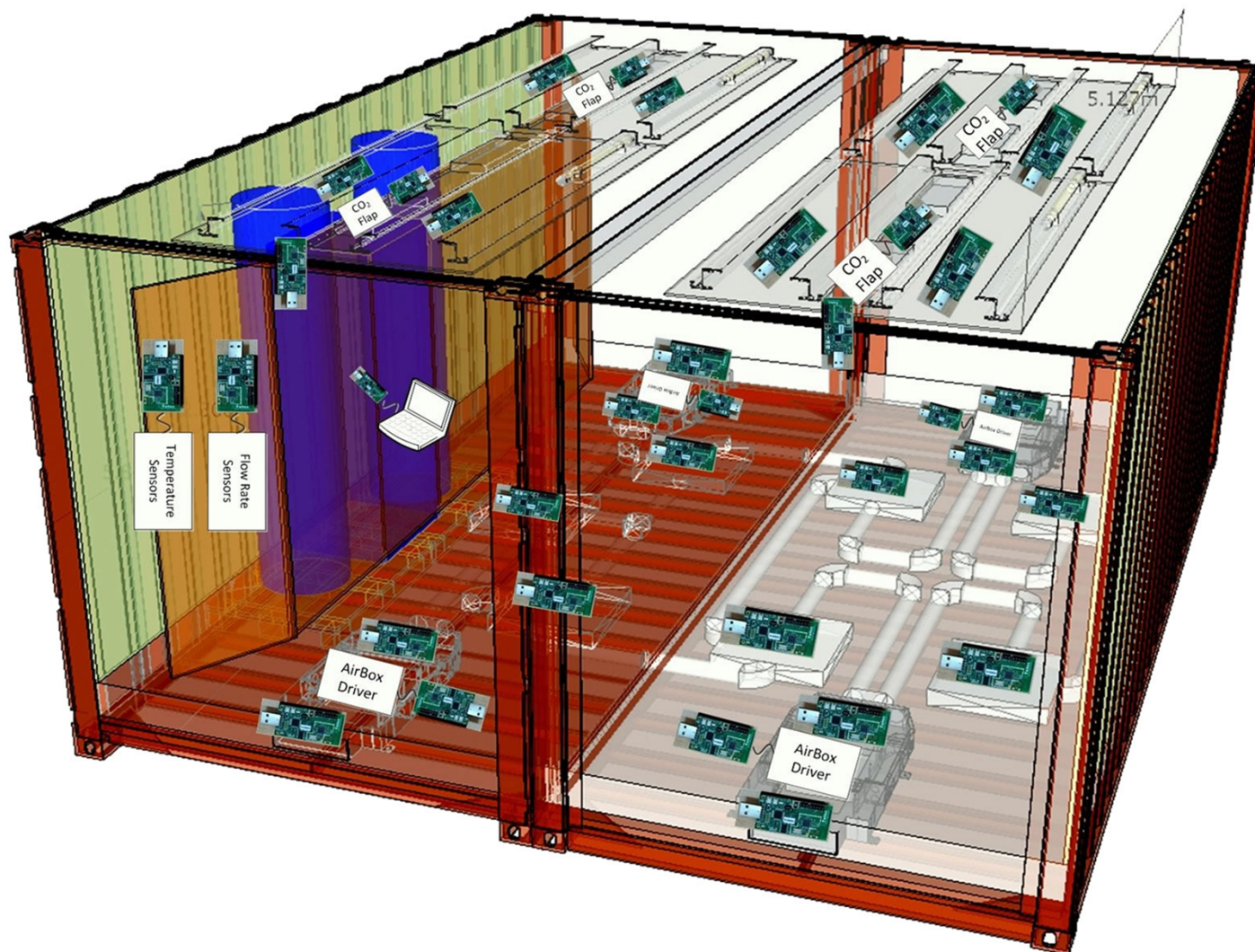
Cost



Current Status of Art

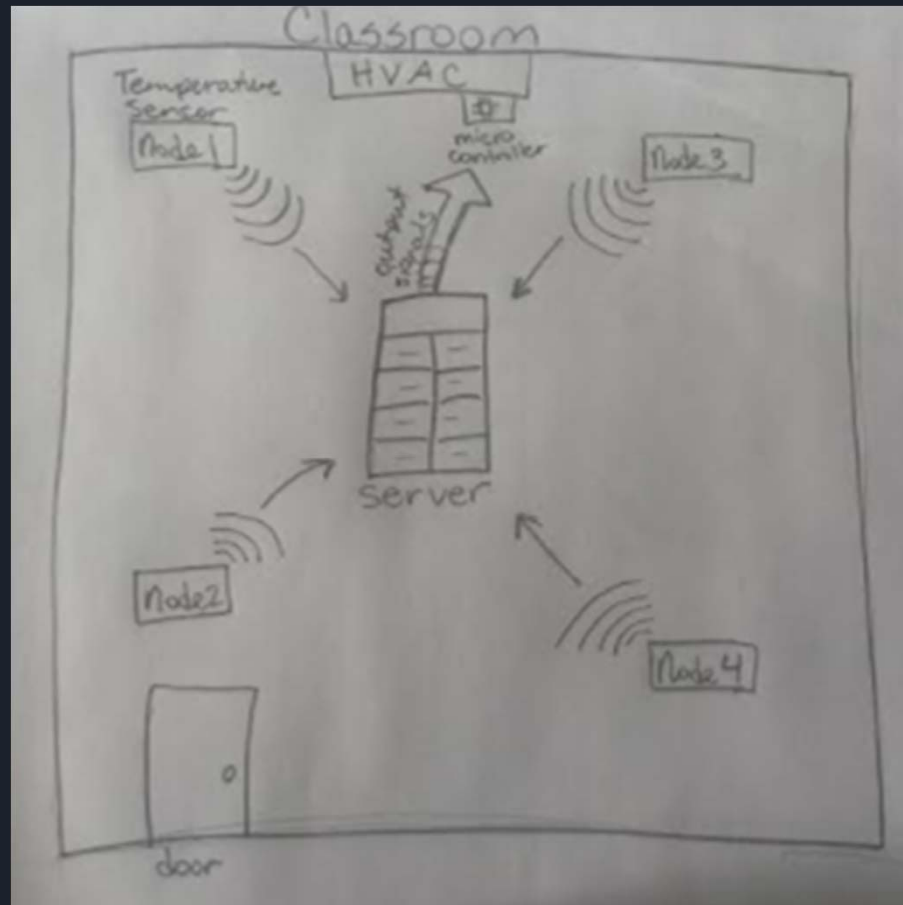






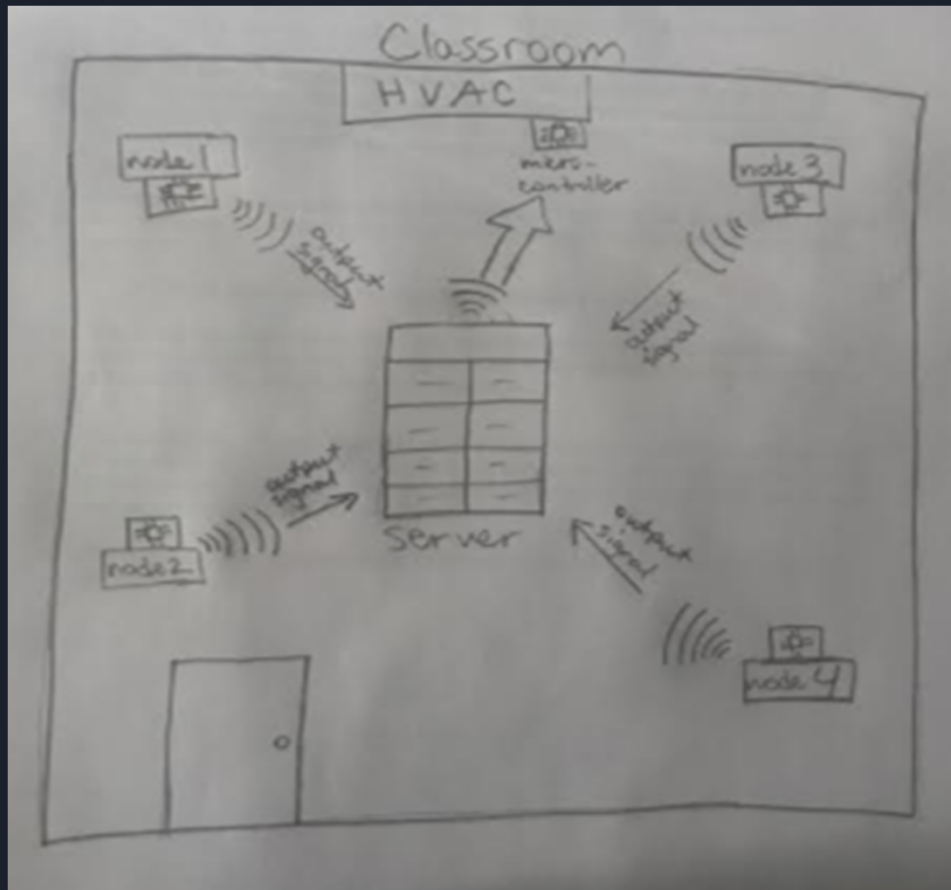
Solution Approaches

Concept 1:



Solution Approaches

Concept 2:





Solution Approaches

Concept 3:

- Attach one external temperature sensor directly to the HVAC unit.
 - Minimizes the distance signals have to travel.
 - Could also be used for error detection of the HVAC's internal system.
 - No external server

Concept 4:

- Using an FPGA device to control the input signals being passed from the sensors to the HVAC
 - FPGA would act as a small scale processor, propagating certain signals from the sensors to the HVAC.
 - No external server.



Solution Selection Process

- The categories used in the decision matrix included:

Cost, Functionality, efficiency, Reliability, and Practicality

- After weighing through the pros and cons of each solution concept in each category, the team decided to narrow down the selection to **Concept 1** and **Concept 2**.



Solution Selection Process

Concept 1:

Pros:

- Not having processors on each node cuts down on cost
- Having an external server provides storage for recording measurements
- Easy to troubleshoot

Cons:

- May cause a slight increase in latency
- Increases the strain on the server's processing power

Concept 2:

Pros:

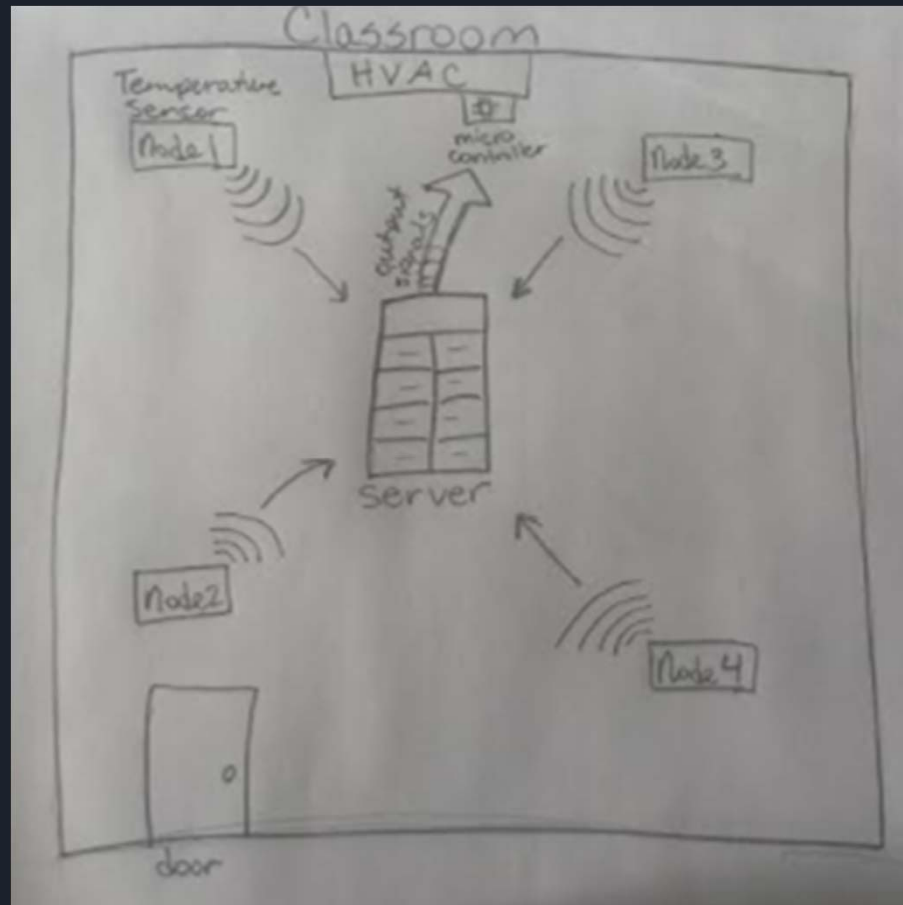
- May slightly decrease latency
- Reduces strain on server's processing power

Cons:

- Puts strain on each node's processing power due to continuous sensing and processing of data
- Harder to troubleshoot each node

Final Solution

Concept 1:





Conclusion

Proposed Solution:

A network of wireless temperature sensors that takes measurements of the temperature in different sections of a room, averages those measurements, and transmits that data to an external database that wirelessly controls the operation of a customized HVAC system.



Thank You

Any Questions?