



# BUILDING INTEGRATED AUTO-ADAPTIVE HVAC SYSTEM



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## Introduction

### Introduction:

Our project introduces an Auto Adaptive HVAC system using AI to optimize cooling based on occupancy, enhancing energy efficiency and comfort sustainably.

### Problem statement:

“Energy Consumption Due to HVAC System is High, and This Affects Operational Costs Negatively “

### Constrains:

- 1- **cost:** Low costs (<15% construction, <8% maintenance).
- 2- **compatibility:** Works with most HVAC systems (<10% retrofitting).
- 3- **power:** Minimal energy use (<0.2 kWh/m<sup>2</sup> daily, <0.5 kWh/m<sup>2</sup> peak).
- 4- **comfort:** High satisfaction (>4.5/5 rating, easy use).

### Target specification:

- 1- **Temperature Control:** Maintain 20°C to 25°C with ±1°C accuracy.
- 2- **Occupancy Detection:** Accurately count occupants with 90% accuracy.
- 3- **Cooling Load Calculation:** Calculate load with ±10% accuracy.

### Project impact:

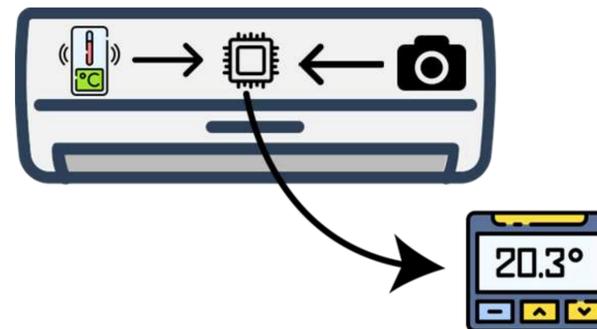
- 1- **Energy Efficiency:** Precise temperature control for less energy.
- 2- **Cost Savings:** Reduced operational costs.
- 3- **Comfort:** Optimal temperature for occupants.
- 4- **Environmental Sustainability:** Reduces carbon emissions and promotes eco-friendly practices.

## How it Works

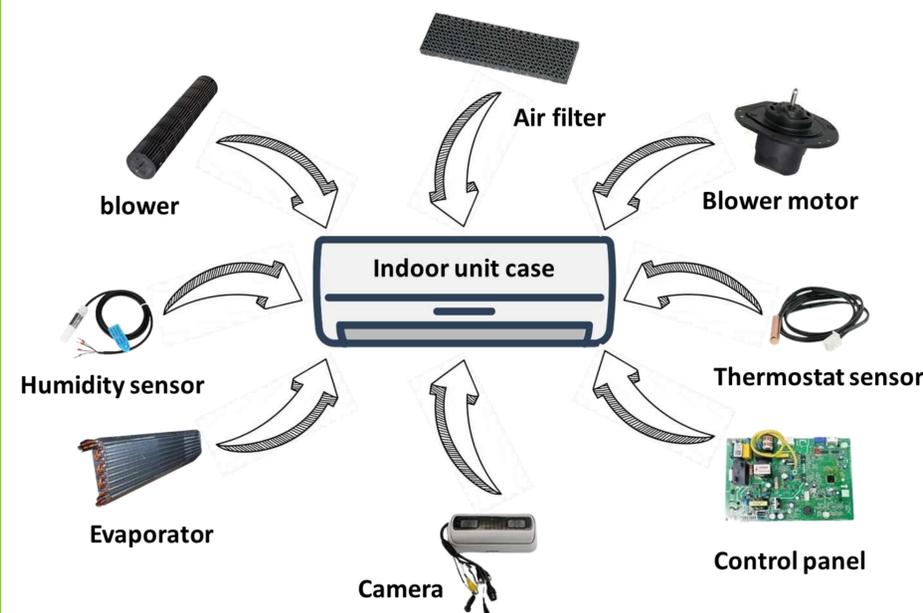
The **temperature and humidity sensor** measures and sends the data to microcontroller.

The **camera** counts the number of occupants and send the data to the microcontroller.

The **microcontroller** process the data and adjust the thermostat accordingly.



## Prototype design



## Follow-Up Tests

### 1- Energy Efficiency:

- **Conventional HVAC:** 8-12 SEER
- **Auto Adaptive HVAC:** 12-18 SEER (50%-100% improvement)

### 2- Occupancy Detection Accuracy:

- **Conventional HVAC:** 0%-5% accuracy improvement
- **Auto Adaptive HVAC:** 20%-30% accuracy improvement

### 3- Environmental Impact:

- **Conventional HVAC:** Higher emissions
- **Auto Adaptive HVAC:** 20%-30% reduction

## Conclusion and Future Work

### Conclusion:

The auto adaptive HVAC system improves energy efficiency, cost savings, and comfort while promoting sustainability.

### Future Work:

Enhancements in algorithms and sensor integration can optimize system effectiveness. Research will result in continuing improvements.

## Reference

ASHREA 90.1, ASHREA 62.1, ASHREA 62.2, ISO 50001.

## Acknowledgements

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