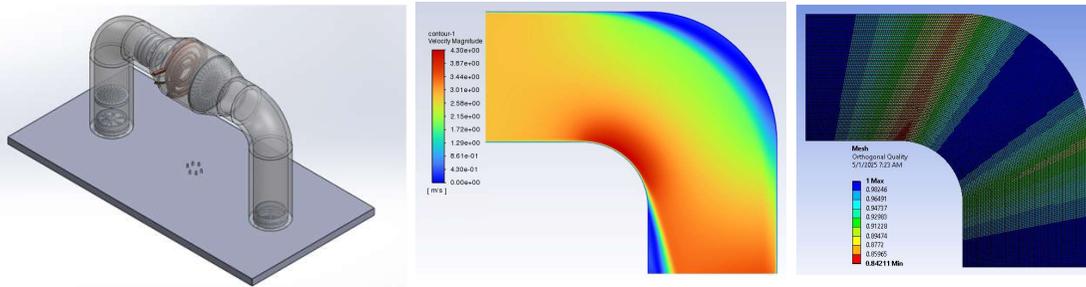
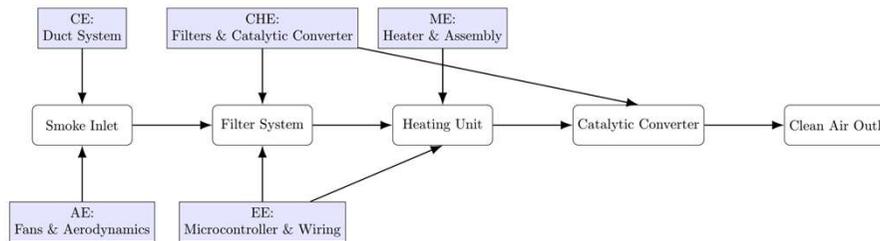




Introduction

- Fire incidents are a leading cause of fatalities, not just from flames but primarily due to smoke inhalation. Traditional fire detection systems lack mechanisms for smoke removal, resulting in poor visibility and high toxicity that delay evacuation and increase casualties.
- This project addresses that gap by introducing a ceiling-mounted smoke purifier that rapidly detects smoke, filters particulates, and chemically converts toxic gases (e.g., CO) into less harmful compounds, enhancing evacuation safety in hospitals, educational institutions.

Prototype



Validation

- The prototype has been successfully built and tested with working subsystems (fans, heater, filters, sensors, microcontroller).
- The system demonstrated effective smoke absorption, visible purification, and real-time sensor response.
- Achieved CO reduction from 500 ppm to <50 ppm within minutes.
- All design constraints were satisfied: fast response, low structural load, thermal resistance, and compact size.

Constraints

- CO \leq 400 ppm within 15 min
- Device weight \leq 50 kg/m²
- Device volume \leq 2 m³
- Duct temperature resistance up to 600 °C
- Reaction time \leq 2 seconds
- Load \leq 1.0–5.0 kN/m²

Specifications

- Final CO output \leq 300 ppm
- Load on structure = 0.65 kN/m²
- Operating temp. up to 600 °C
- Airflow speed = 600–800 RPM
- Microcontroller update rate = 1 second
- Power consumption = 20025 W
- CO reduced from 500 ppm to < 50 ppm

Conclusion

- The project offers a novel, cost-effective, and compact smoke purification system for fire emergencies. It significantly extends survival time by improving air quality and visibility, meeting fire safety standards (NFPA, SBC, etc.), and providing ease of installation and maintenance. With further development, this system could become a standard safety device in high-risk indoor environments.