Vent Booster

Joe Campos EE
Philippe Asaad EE
Ryan Deleon COE
Andrew Teran EE

Project Objectives

This project introduces a vent booster system designed to optimize central air conditioning efficiency. Using mechanical and electrical components, it enhances duct airflow, ensuring temperature balance. Featuring a user-friendly interface and smart home integration potential, it caters to comfort-seeking homeowners and energy-conscious consumers. Addressing the need for cost-effective, energy-efficient climate control, it boosts existing HVAC airflow. This device improves HVAC efficiency and reduces energy consumption.

Design Objectives and Specifications

- Technical Goals:
  - Improve Ventilation
  - Maintain Air Quality
  - Ensuring Energy Efficiency
  - Prioritizing Safety

- Specifications:
  - Materials
    - Arduino Mega 2560 REV3 [A000066]
    - 18/2 stranded wire
    - 14/2 solid
  - Size of the vent booster
    - 6in x 10in
  - Airflow Capacity
  - Power Requirements
    - 12V DC/ 8W
    - 0.33 A
  - Maintenance Needs

Projected Community Impact and Relevant Ethical Issues

1-Improved Air Quality

2-Energy Efficiency

3-Health Benefits

4-Noise Pollution

Economic Impact

- Dependency
- Health Disparities

Constraints and Standards

- Constraints:
  - Budget
  - Space(Area of the booster)
  - Target Energy Efficiency levels
  - Noise and Vibration Control
  - Sustainability
    - Low Maintenance
  - Fire and Electrical Safety

- Standards:
  - Installation-
    - **IEEE # 484-2019,** "IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications
  - Interface-
    - **IEEE # C37.92-2023**, "IEEE Standard for Low-Energy Analog Interfaces between Protective Relays and Power System Signal Sources"
    - **IEEE # 21451-2-2010**, "Smart transducer interface for sensors and actuators -- Part 2: Transducer to microprocessor communication protocols and Transducer Electronic Data Sheet (TEDS) formats"

Approach, Methods and Procedures

Approach:

- **Objective**:
  - Clearly define the goal of installing a vent booster. Which is to improve overall airflow, and target specific areas.
  - Used code to set parameters desired for users in the home.

Methods:

- **Hardware**:
  - Researching and choosing the appropriate equipment like power source, muffin fans, and transistors to build a vent booster.
  - Making sure the power source and other hardware components are compatible.
- **Software**:
  - Writing software for Arduino and making sure all parameters acceptable.

Testing:

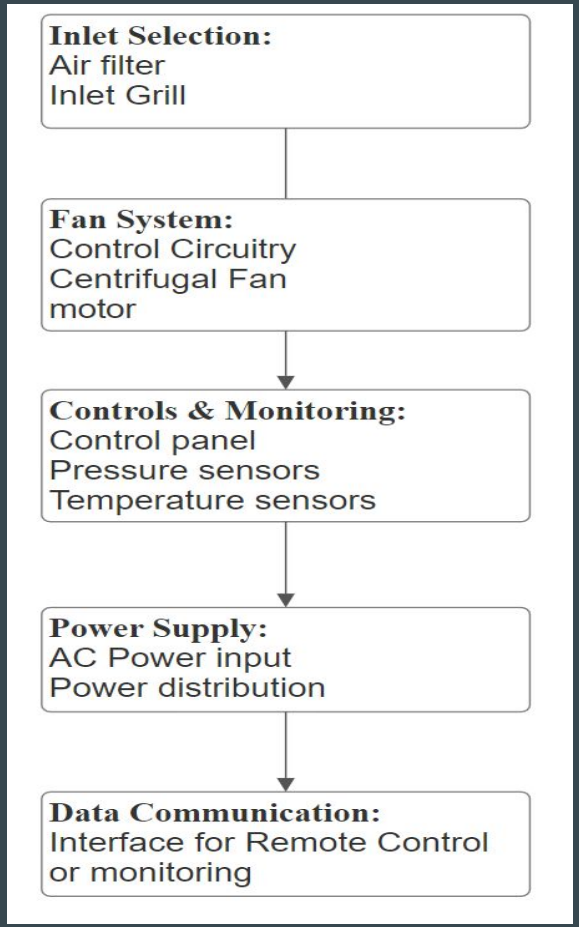
  - Making sure the Arduino code worked and was able to carry out the specific duty it was asked
  - Making sure all the components were working properly.

Procedures:

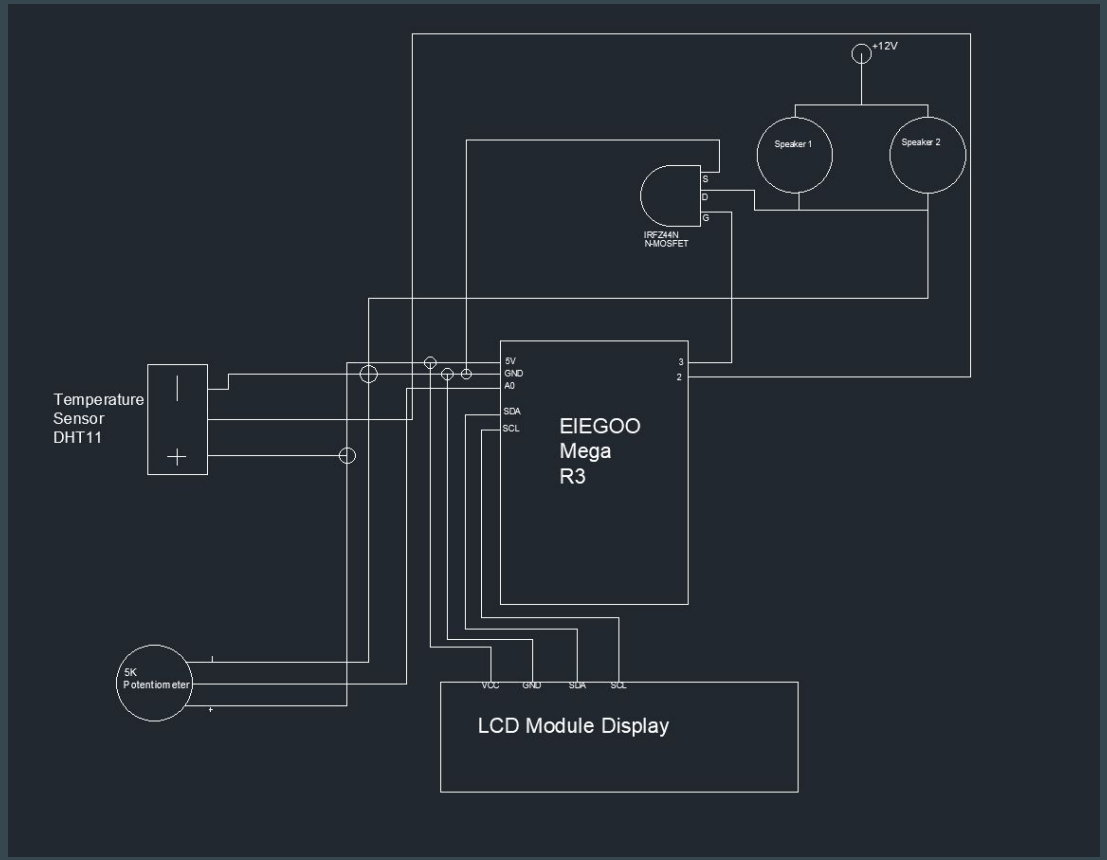
- **Preparation**:
  - Gather data and testing equipment to ensure it was safe and reliable.
  - Test vent booster a variety of different times to ensure quality control.
- **Finalization**:
  - After testing vent booster all components were set in place by being soldered.
  - Vent booster then was package neatly to be presented.

Components and Block Diagram

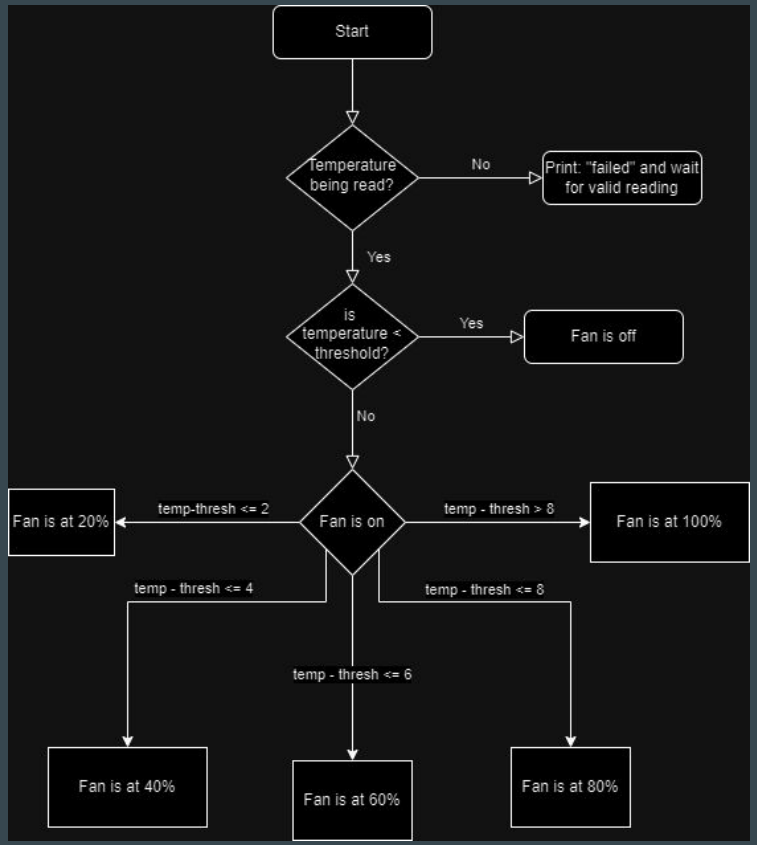
- Components:
  - Electrical-
    - Motor, Power Supply, Control System, Wiring, Remote Control, Sensors, LED indicator, and Thermal protection
  - Mechanical-
    - Fan, Casing, Dampers, Flanges, BEaring, Shaft, Blades, Safety guards, Piping, Vibration Isolating Components
  - Software-
    - Arduino, Software language(C++), Safety software, User interface, Control software, Data logging Software



Circuit Wire Diagram



Software Flow Chart

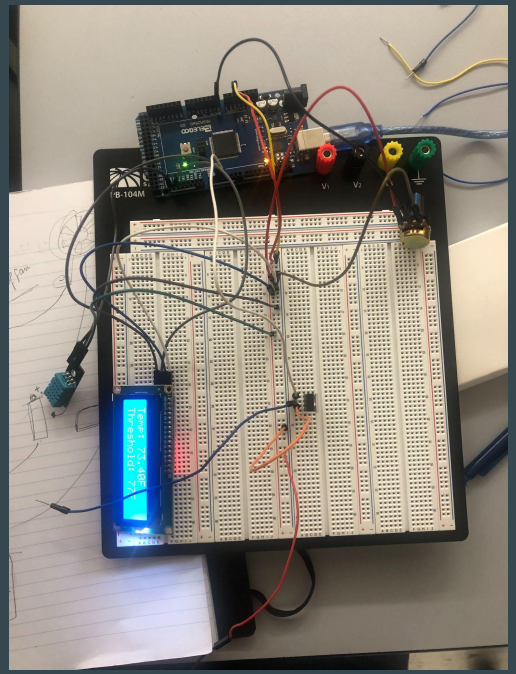


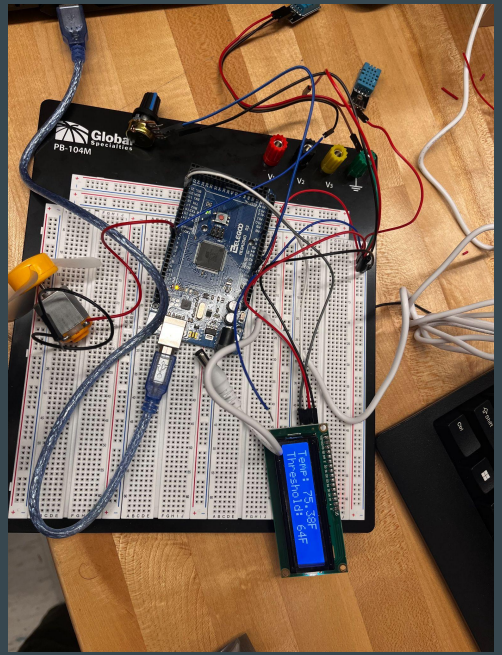
Prototyping, Verification, Testing & Assembly

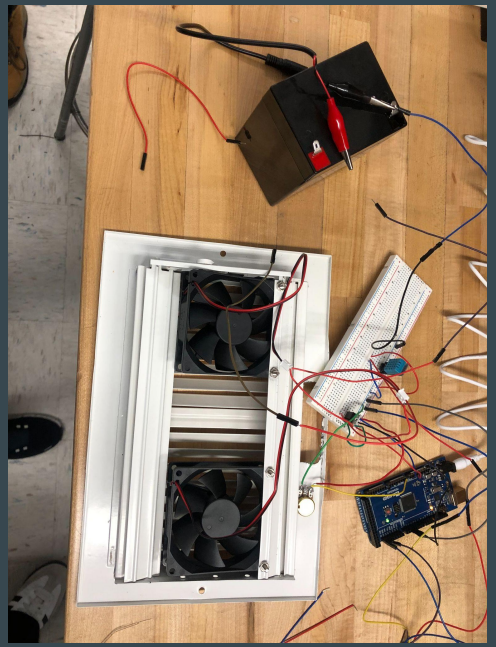
- Prototyping:
  - Working Prototype
- Validation:
  - Prospective Validation, make a product that meet safety regulations and legislative forms.

1. Create a conceptual design of the vent booster, including its size, shape, and how it will fit into existing ventilation systems. Consider factors such as airflow rate, energy efficiency, and noise levels.
2. Choose suitable materials for constructing the vent booster. Ensure that the materials are durable, safe, and suitable for the intended environment.
3. Select the necessary components, such as fans, motors, sensors, and control systems.
4. Test the prototype in a controlled environment to evaluate its performance.
5. Analyze the data collected during testing to assess the effectiveness of the vent booster in achieving your objectives.

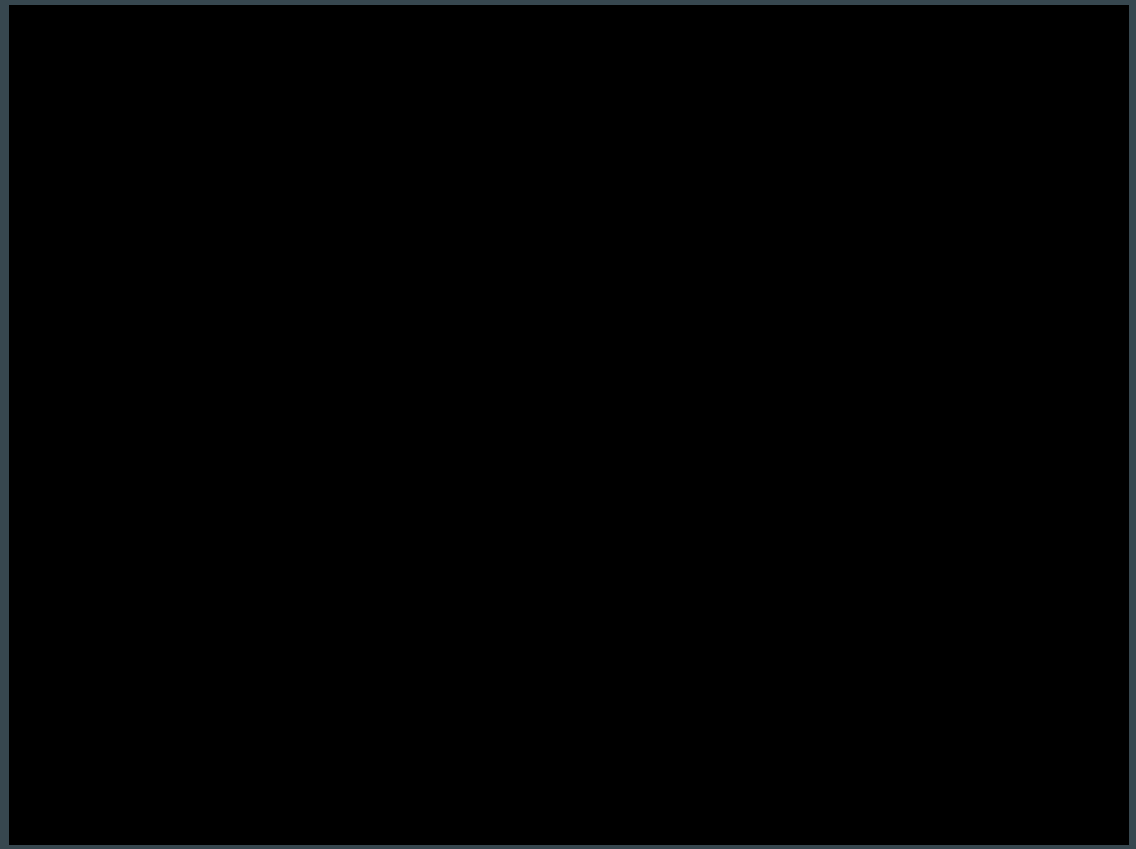
Prototyping Experiments







Verification and Validation



Vent Booster Budget

Vent Booster Budget	
Materials	Price
Fan axial(2)	$20.00
Breadboard Wire kit	$11.36
components(NPN Mosfet,Potentiometer, Sensor, LCD Module Display)	$14.90
Vent frame	$15.00
Arduino R3	$14.99
12V Battery	$23.80
Total	$100.05

Learning Experience

- Throughout the process of this project we were able to witness How Mosfets work in practical application.
- We understood to power 12V fans we need to amplify the signal the microcontroller using the N-type MOSFET.
- Temperature Sensors are sensitive to touch, and can break easily.
- Bluetooth applications work better with android phones than apple products.

Future Potential

- Smart Home Interface
- Smart Home Application Via Bluetooth
- Mass production for homeowners, and rental spaces.
- More compact design

Conclusion

- In our collaborative effort to design and propose a vent booster, we successfully completed several crucial tasks that laid the foundation for our project. Our initial focus was on researching the necessary parts and software required for the construction of the vent booster.
- The face-to-face meetings were instrumental in fostering a comprehensive understanding of our individual strengths and areas of expertise, leading to a more effective division of tasks.
- Simultaneously, we delved into researching the budget and costs associated with the project.
- Understanding that trials and errors are inherent in any project, we tackled these issues in the project.
- We have successfully produced a working prototype.
- As we move forward, our focus will shift towards achieving a clean aesthetic product.
- Produce an application user friendly product.

References

- Hussain, Nayeem, et al. Smart Vent and Atmospheric Controller Apparatuses, Methods and Systems.
- Bergman, Gabriel, et al. Remote Control of an HVAC System That Uses a Common Temperature Setpoint for Both Heat and Cool Modes.
- Zou, Shazhou, et al. Multiple Zone Climate Control System.
- "ISO/IEC/IEEE International Standard for Information technology -- Smart transducer interface for sensors and actuators -- Part 2: Transducer to microprocessor communication protocols and Transducer Electronic Data Sheet (TEDS) formats," in ISO/IEC/IEEE 21451-2:2010(E) , vol., no., pp.1-130, 15 May 2010, doi: 10.1109/IEEESTD.2010.5668463.
- "IEEE Standard for Low-Energy Analog Interfaces between Protective Relays and Power System Signal Sources," in IEEE Std C37.92-2023 (Revision of IEEE Std C37.92-2005) , vol., no., pp.1-32, 25 April 2023, doi: 10.1109/IEEESTD.2023.10106648.
- "IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications," in IEEE Std 484-2019 (Revision of IEEE Std 484-2002) , vol., no., pp.1-29, 17 July 2020, doi: 10.1109/IEEESTD.2020.9141541.
- Macfos. “Temperature Controlled Fan Using Arduino - Step by Step Guide with Code - Robu.in: Indian Online Store: RC Hobby: Robotics.” *Robu.in | Indian Online Store | RC Hobby | Robotics*, 5 Feb. 2021, robu.in/temperature-controlled-fan-using-arduino-step-by-step-guide-with-code/#:~:text=And%20a%20DHT11%20sensor%20module,fan%20speed%20through%20the%20transistor.