Mushroom Incubator

Electrical & Computer Engineering

ECE 445: Team 6

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Problem Statement and Solution

What, Why, and the Current Market

Problem Statement and Solution

Grow at your own risk!

- Biological
- Electrical
- Overheating

… actually, just let us take care of it!

- Clean Air Filtration
- Electrical testing
- Sensor-Regulation
- Thermal Fault Max

Joel Orchard

Cost Analysis, Market Comparison

What's Available Now?

- **Shrooly**:
  - $299
  - 15.2" x 12" x 7.5" (.78 Cubic Feet)
  - No User Settings, Non-Expandable
- **The Mushroom Ecosphere 3.0**: $249.99
  - 29" X 20" X 63.5" (17.7 Cubic Feet)
  - User-Set Up
- **Our Mushroom Incubator**:
  - $120
  - 15" x 15" x 27" (3.5 Cubic Feet)
  - User-Settings, Expandable Design

https://shrooly.com/

Midwest Grow kit

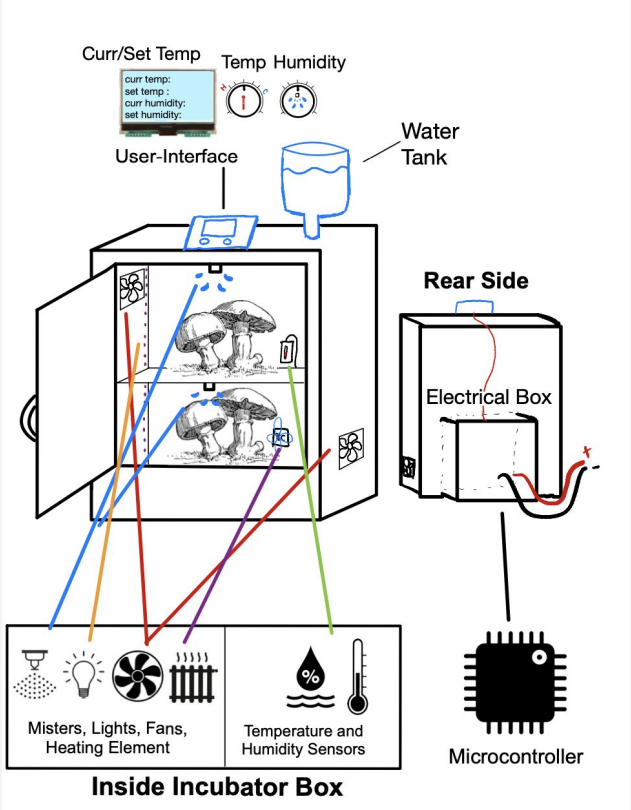
Design and Modifications

High-Level Overview of Subsystems and Modifications Made

Product Design

Physical Design:

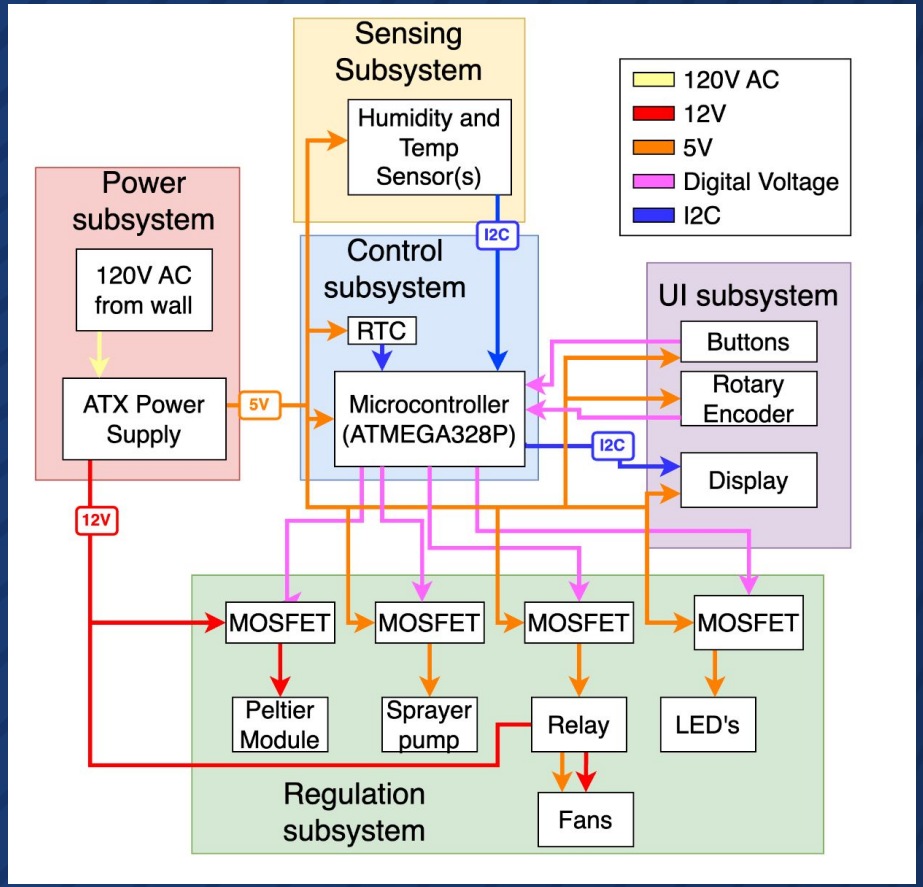
- Sensing
- Regulation
- UI
- Control
- Power



Design Concept Visual Aid

Subsystems and Requirements

Subsystem Overview, Interactions, High-Level Requirements



Subsystem Interactions:

Sensing Subsystem
Regulation Subsystem
UI Subsystem
Control Subsystem
Power Subsystem

High-Level Requirements:

Heating
Cooling
Humidity
Lights
Air Quality
UI

Modular Design and Testing

Separate design, testing, and functionality of subsystems

Printed Circuit Board (Control Subsystem)

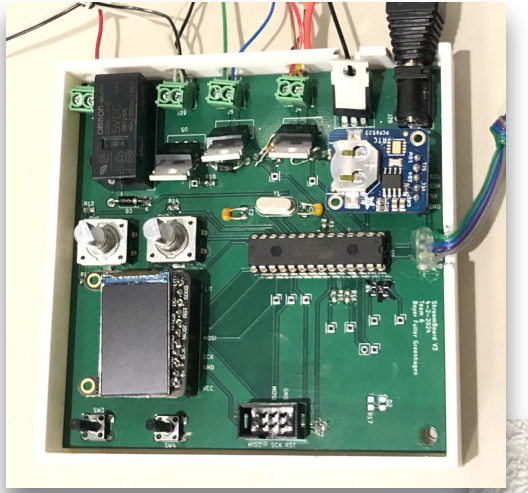
Design Choices: DIP vs SMD, test points

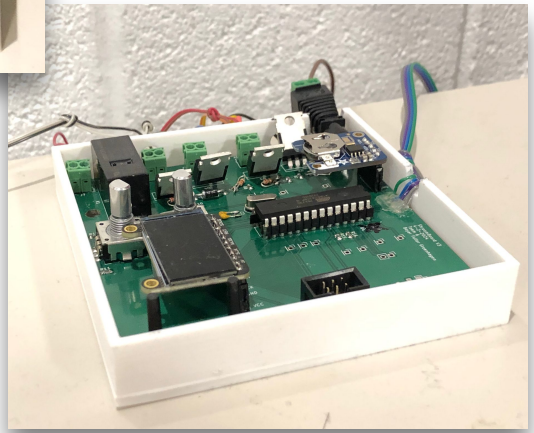
PCB Version 1

- Minimalist setup to test functionality

PCB Version 2

- Buttons, knobs, screen organized for UI
- Fan control relay
- Screw terminals, power jack





No Major Development Issues

- Programming, display, I2C sensors all functional in each version

User-Interface

Design Choices: Rotary Encoders, I2C

UI Version 1

- Breadboarded with RedBoard with LCD screen alone

UI Version 2

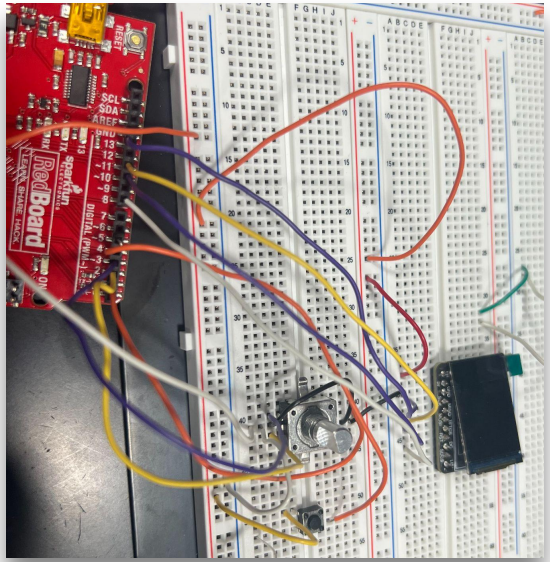
- Expanded breadboard with a rotary encoder and button

UI Version 3

- Connected to PCB/ATMEGA328p

No Major Issues!

- Programming, display, I2C sensors all functional



Regulation/Sensing Subsystem

Design Choices: Fan/Heater Size, Sprayer Automation, Sensor Parameters

Regulation Subsystem Version 1

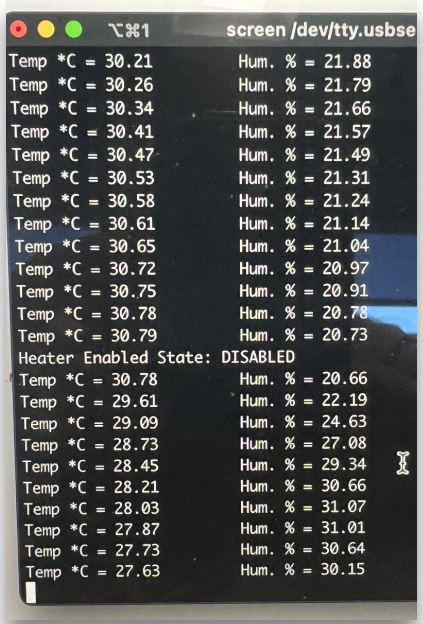
- Breadboarded with RedBoard and test programs

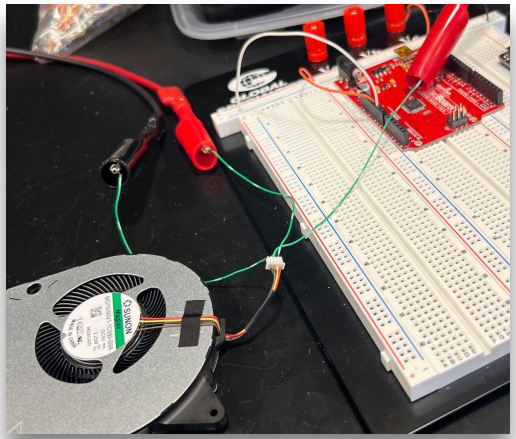
Regulation Subsystem Version 2

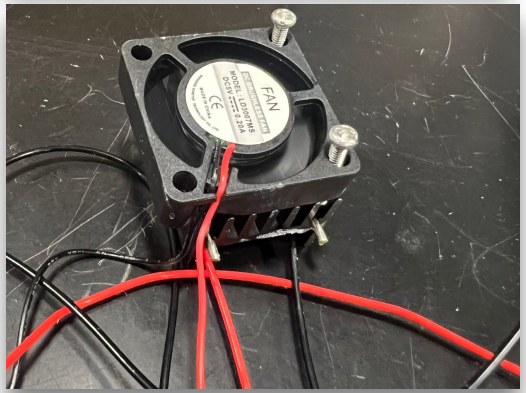
- larger fans, soft-interrupt based programming for reading sensors and activating fans/heater/lights

Regulation Subsystem Version 3

- Connected to PCB/ATMEGA328p







Power Subsystem

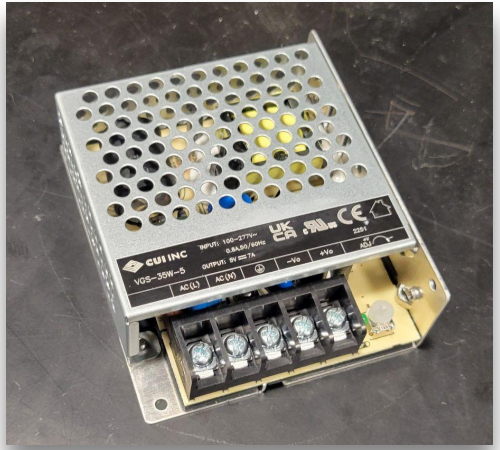
Design Choices: Desired Power Supply, Supply Parameters

Power Version 1

- 5V power supply and a 12V AC to DC adapter cable

Power Version 2

- 700W ATX power supply provides both 5V and 12V constantly.



Putting it all together…

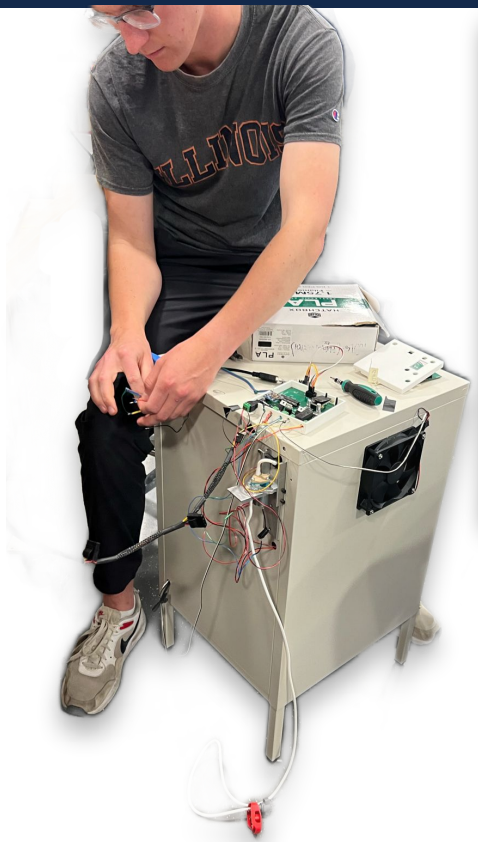
Design Choices: Water Tank Placement, Power Subsystem Placement

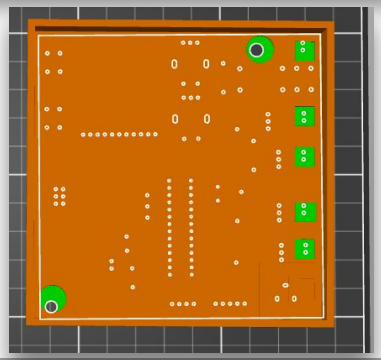
Version 1

- Smaller TEC, 5V supply and adapter

Version 2

- Larger TEC, ATX power supply, insulation, PCB enclosure, wire management





Results

Qualitative and Quantitative Results, Successes, and Challenges

R&V: Control Subsystem

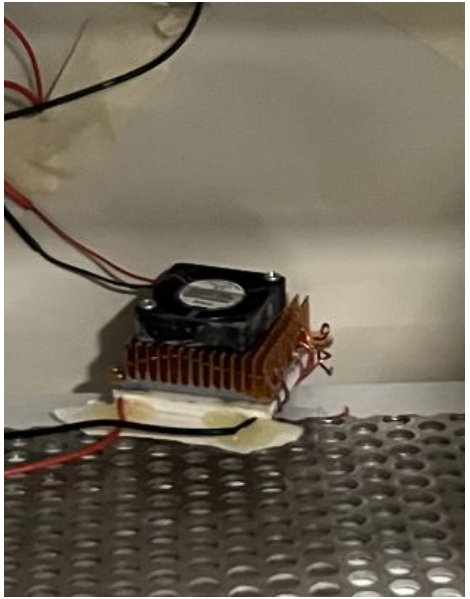
- User-controlled set points for temperature humidity ☑
- Displays accurate time-of-day ☑

R&V: Power Subsystem

- System provides 5V(±0.3V) up to 3.6A ✓
- System provides 12V(±0.3V) up to 5A ✓

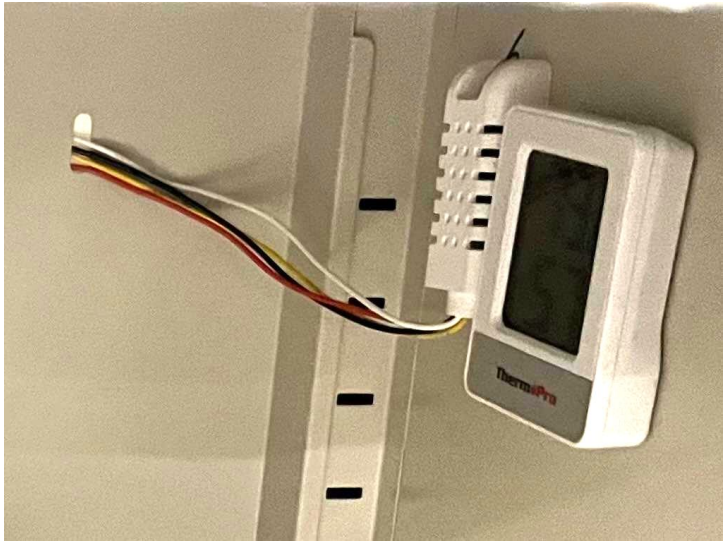
R&V: Regulation Subsystem

- Heater and fans respond appropriately ☑
  - Temperature adjusts at 1℉/min.
- Mister responds appropriately ☑
  - Humidity increases at 1%/min, decreases at 0.5%/min



R&V: Sensing Subsystem

- The sensors must both be able to withstand a temperature of 70-85°F and a humidity between 70-95% for prolonged periods. ✓
- It must be supplied 5V +/- 0.5V at .98mA. ✓



R&V: UI Subsystem

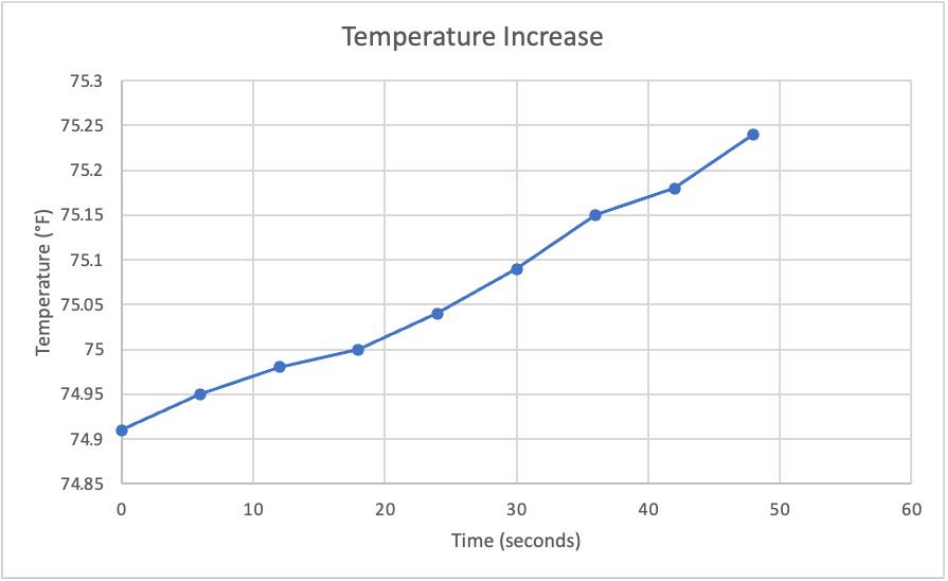
- Knobs and buttons update set points ☑
- Current temp and humidity displayed with set points ☑

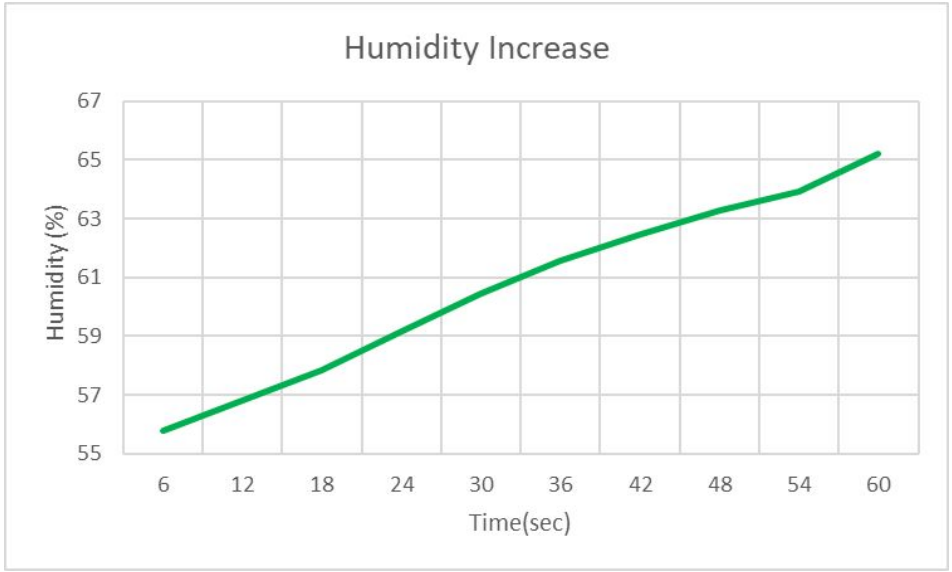
Qualitative:

- All aspects of the project worked in the demo
- Temperature/Humidity control worked within our desired time constraints
- UI subsystem was responsive
- No major power shorts or other such issues.

Image credit: iStock

Quantitative:





Successes

- Project completed on time and under budget
- Useful feedback from TA's and Machine Shop

Challenges

- Peltier troubles
- Power supply troubles
- Balance between updating UI frequently and keeping display clean
- Fan system from PWM to 2 power supplies

What We Learned:

- Improved ability to code in Arduino
- Working with physical materials
- Interdisciplinary collaboration
- Mushroom growing practices

BLAINE MOATS

Future Work

Possible areas for improvement:

- Improve waterproofing
- Stylize the appearance more
- Improve insulation
- Improve water sprayer to provide a finer mist
- Contact marketing team

Thank you for coming to our presentation!

Thank you to Abhisheka, Professor Gruev, the machine shop, and the rest of the ECE 445 course staff for their advice and support.

Questions?

The Grainger College of Engineering

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2024