Specifications

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Signature Page

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Revision History

Revision	Description	Author	Date	Approval
1	Draft	Zach Wilcox	11/5/21	
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Contents

1 SCOPE

(a) **General:**

This document describes the design and verification of a desktop-sized environmental monitoring and control system. This system will take the form of a box with knobs as inputs, and a display that will display the current values read by the input sensors. This system will monitor temperature, humidity, and Carbon Dioxide levels in the box, and will adjust the conditions to match the values input by the user. It will also light the contents of the box for the amount of time per day specified by the user. It is expected that the user refill the water tank for humidity, and replace filters as needed.

2 APPLICABLE DOCUMENTS

The following documents shown shall form part of the specifications for this project. In the event of a conflict between requirements, priority shall first go to the contract, second to this document, and lastly to these reference documents.

(a) **Government Documents**

- MIL-H-22577C - Heating element
- F-C-2791 - Cooling element
- FED-STD-65C - Fans

(b) **Industry Documents**

- IEC 60035 - Power supply

3 STAKEHOLDER REQUIREMENTS

3.1 Input

1. User can define their desired environmental conditions

3.2 Output

1. System will adjust environment within box to match input levels
2. System will display the current environmental conditions within the box

3.3 Reliability

1. System will last at least 2 years

3.4 Maintainability

1. Must easily be able to access and replace filters for air and humidity.

3.5 Performance

1. must reliably keep parameters in set range.

3.6 Accessibility

1. Easily adjust parameters using knobs and buttons
2. Read outputs on display

3.7 Environmental Conditions

1. Main chamber must be resistant to dirt, dust, and water

3.8 Safety

1. Electric, cooling, and heating components must be properly enclosed to ensure safety

3.9 Security

1. Electronic components, heating element, cooling element must not be modified by unauthorized persons.

3.10 Quality Provisions

1. Water must be replaced periodically depending on usage
2. Filters must be replaced 1-2 times per year

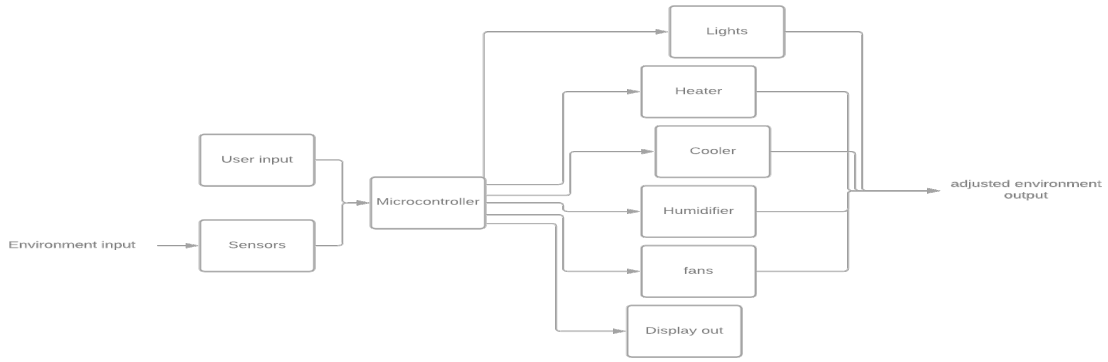
3.11 Policy and Regulatory

1. Heating system safety regulations
2. Power supply safety regulations
3. Refrigerant environmental regulations

4 ENGINEERING REQUIREMENTS

4.1 Item description

1. Functional Block Diagram:



2. Interface definition:
   The environmental input shall be the temperature, humidity, and carbon dioxide levels in the main chamber of the box. The user input shall be simple knobs that can select a level between predetermined ranges. The input shall be processed and the output systems shall be engaged to bring the sensed levels to match the levels input by the user. The display shall indicate current levels read from the sensors.

4.2 Physical

1. Box shall be no larger than 24 in. x 24 in. x 24 in.
2. Box shall weigh no more than 50 lbs.

4.3 Electrical

1. System shall be powered by a standard American 120 V, 60 Hz household outlet

4.4 Economic

1. The system prototype shall have a one-time cost of under $250

4.5 Input

1. User shall be able to specify a temperature between 10 °C and 40 °C
2. User shall be able to specify an accepted degree of variation from the specified temperature between 1 °C and 10 °C
3. User shall be able to specify a humidity percentage between 25% and 95%
4. User shall be able to specify an accepted degree of variation from the specified humidity between 1% and 10%
5. User shall be able to specify an amount of hours per day to light the contents of the box from 0 hr. to 24 hr.
6. User shall be able to specify the maximum desired carbon dioxide levels from 4,000 ppm to 10,000 ppm.

4.6 Output

1. System will blow heated or cooled air into the chamber to bring levels within specified parameters
2. System will turn on humidifier or dehumidifier to bring levels within specified parameters
3. System will turn on lights inside of box for specified amount of hours each day
4. System will turn on external fan to bring in air from outside of box when carbon dioxide levels rise above input maximum level
5. System will cycle displaying each parameter read from sensors within box

4.7 Reliability

1. System shall have a mean time to failure of 2 years

4.8 Maintainability

1. Users must have access to filter locations to replace as needed

4.9 Performance

1. System must keep internal parameters within specified bounds at all times
2. The water tank shall hold enough water for at least 24 hours of operation

4.10 Accessibility

1. All knobs must have labels indicating parameter and range of possible values
2. Display must clearly indicate the metric currently being displayed and the current value

4.11 Environmental Conditions

1. Bottom 6 in. of main chamber shall be resistant to any amount of soil
2. Main chamber shall be resistant to water mist and minor splashes

4.12 Safety

1. The system shall have all electrical components enclosed in a manner to withstand all environmental conditions of the main chamber
2. The system shall not have any exposed conductors
3. The system shall have all wires and cables correctly secured and protected
4. Power supply and connections shall meet requirements specified in IEC 60035
5. Heating element shall meet requirements specified in MIL-H-22577C
6. Cooling element shall meet requirements specified in F-C-2791

4.13 Security

1. Users shall not have access to view or modify micro-controller programming

4.14 Quality Provisions

1. User shall replace filters every 6 months or as needed due to buildup
2. User shall refill water reservoir as when depleted

4.15 Policy and Regulatory

1. Heating system: MIL-H-22577C
2. Power system: IEC 60035
3. Cooling system: F-C-2791
4. Fans: FED-STD-65C

5 VERIFICATION OF REQUIREMENTS

Possible verification methods include:

1. Inspection:
   Inspection is a method of verification consisting of investigation, without the use of special laboratory appliances or procedures, to determine compliance with requirements. Inspection is generally nondestructive and includes (but is not limited to) visual examination, manipulation, gauging, and measurement.

2. Demonstration:
   Demonstration is a method of verification that is limited to readily observable functional operation to determine compliance with requirements. This method shall not require the use of special equipment or sophisticated instrumentation.

3. Analysis:
   Analysis is a method of verification, taking the form of the processing of accumulated results and conclusions, intended to provide proof that verification of a requirement has been accomplished. The analytical results may be based on engineering study, compilation or interpretation of existing information, similarity to previously verified requirements, or derived from lower level examinations, tests, demonstrations, or analyses.

4. Direct Test:

   Test is a method of verification that employs technical means, including (but not limited to) the evaluation of functional characteristics by use of special equipment or instrumentation, simulation techniques, and the application of established principles and procedures to determine compliance with requirements.

5.1 Verify Coverage of Stakeholder Requirements

Paragraph Number	Test Type	Tester's Name	Pass/Fail	Date