Phase Cool

ENME 444: Mechanical Engineering Systems Design, Spring 2020

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Objective

Background: Many towns in East Africa lack some resources that inhibit them from keeping their produce fresh. Farmers experience high-value crop loss due to the lack of refrigeration.

Task: Design a refrigeration system that cools and preserves produce without relying on grid electricity and harmful materials.

System Requirements

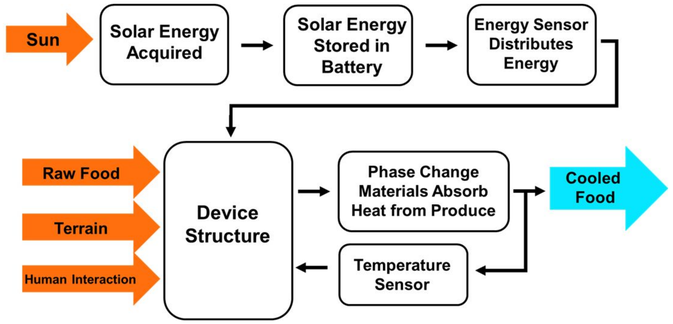


Figure 1: Functional Block Diagram

The key system requirements include:

- Shall operate without a connection to grid electricity
- Shall operate without the use of a refrigerant.
- Shall be portable in size
- Shall be securely attached to a motorcycle rickshaw
- Shall include phase change matter/materials
- Shall maintain an internal temperature of around 35°F
- Shall have a tight seal that prevents temperature fluctuation of ± 5°F
- Shall be battery operated for a minimum of 24 hours

Mission Scenario

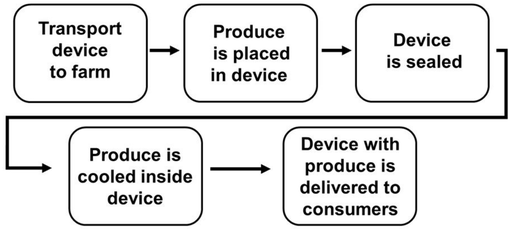


Figure 2: Mission Scenario Diagram

Prototypes

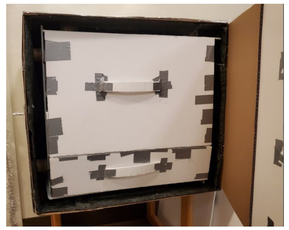


Figure 3: The first prototype focused on a simple system with two drawers, one door, and space in the back for the electrical components.

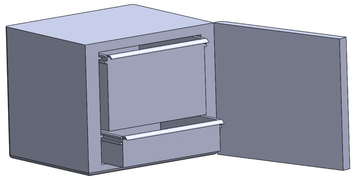


Figure 4: The second prototype included minor adjustments to the size, additional space for the electrical components, and drawer tracks.

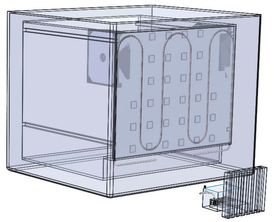
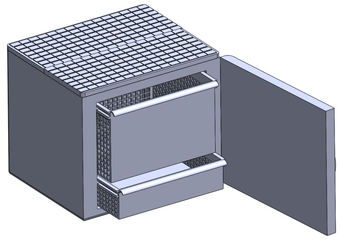


Figure 5: After the second prototype, the subsystems including the Peltier cooling devices, heat sinks, fans, and water pump were assembled.

Design and Development

Figure 6: The final design focuses on changes made to the previous prototype that improved the function of the overall device.



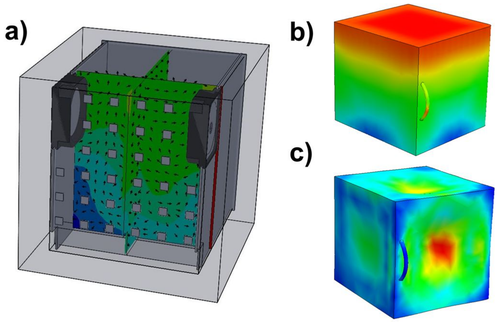


Figure 7: Final design simulations, thermal (a), drop test (b), and static (c), illustrate how the subsystems will work together to cool the device efficiently.

Future Work

- Perform drop test and fluid simulations and adjust the design as necessary.
- Finalize design on Solidworks
- Attach refrigeration device onto the back of a motorcycle rickshaw

SOLIDWORKS SIMULATION

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