Atmospheric Vapor Extraction Device

Final Presentation

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December 8, 2015

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Overview

- Introduction
- Problem Statement
- Course of Action
- Sensors
- Design
- Bill of Materials
- Conclusion

Introduction

- Mr. Chris Allender wants a device that measures the effectiveness of extracting water from air

- This device should have a maximum cost of $1,000 and also be portable enough for one person to transport

- The device must measure the atmospheric conditions and water produced

Need Statement

There is not enough research to determine if extracting water from air is a viable option in arid environments.

Project Goal

Create an atmospheric vapor extraction device for researching optimal operating conditions.

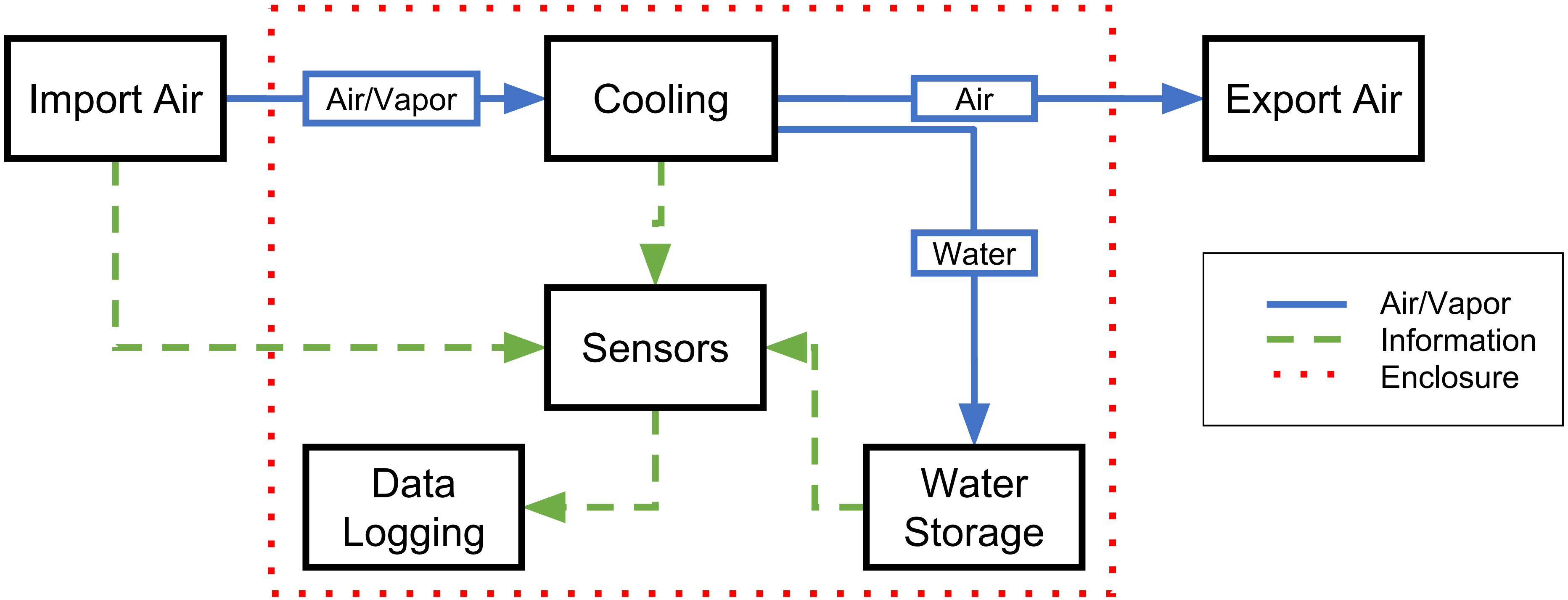
Objectives

rqmt. #	Function	Engineering Requirement	Unit of Measure
1	Collection	collect water	kg
2	Portable	small enough to move	m^3
3	Low Cost	low cost to build	$

Constraints

rqmt. #	Function	Engineering Requirement	Unit of Measure	Value
1	Sensing	equip enough sensors	#	
2	Data Logging	enough data storage	MB	
3	Production	cost of production	$	<1,000
4	Power Usage	limit power to avg home	W	
5	Power Source	must not use 220v power source	Y/N	

Functional Diagram



Analytical Hierarchy Process

Judgement of Preference	Numerical Rating
Extremely preferred	9
Very strongly preferred	7
Strongly preferred	5
Moderately preferred	3
Equally preferred	1

Power Source						
	Size	**Weight**	**Initial Cost**	**Running Cost**	**Reliability**	**Ease of Use**
Size	1	1/3	1/5	1/5	1/7	5
Weight	3	1	1/5	1/5	1/7	3
Initial Cost	5	5	1	3	3	5
Running Cost	5	5	1/3	1	1/3	3
Reliability	7	7	1/3	3	1	3
Ease of Use	1/5	1/3	1/5	1/3	1/3	1

Normalized Criteria

Power Source							
	Size	**Weight**	**Initial Cost**	**Running Cost**	**Reliability**	**Ease of Use**	**Rel. Weight**
Size	0.047	0.018	0.088	0.026	0.029	0.250	**8**
Weight	0.142	0.054	0.088	0.026	0.029	0.150	**8**
Initial Cost	0.236	0.268	0.441	0.388	0.606	0.250	**35**
Running Cost	0.236	0.268	0.147	0.129	0.067	0.150	**17**
Reliability	0.330	0.375	0.147	0.388	0.202	0.150	**27**
Ease of Use	0.009	0.018	0.088	0.043	0.067	0.050	**5**

Relative Weights

Power Source	
size	8
weight	8
initial cost	35
running cost	17
reliability	27
ease of use	5
	100

Sensors/Data Logger	
cost	13
reliability	29
accuracy	52
ease of use	6
	100

Refrigerator	
size	13
weight	20
initial cost	27
running cost	15
reliability	25
	100

Decision Matrix - Power Source

	Wind	Solar Panels	Generator	Outlet	Battery
Size	0.33	0.57	0.51	1.02	0.87
Weight	0.48	0.68	0.40	1.28	0.92
Initial cost	1.15	1.15	1.15	2.16	1.49
Running cost	0.78	0.90	0.39	0.69	0.72
Reliability	0.84	1.16	1.26	1.42	1.05
Ease of use	0.39	0.57	0.63	0.96	0.90
Total	3.97	5.02	4.34	7.53	5.95

Decision Matrix Results

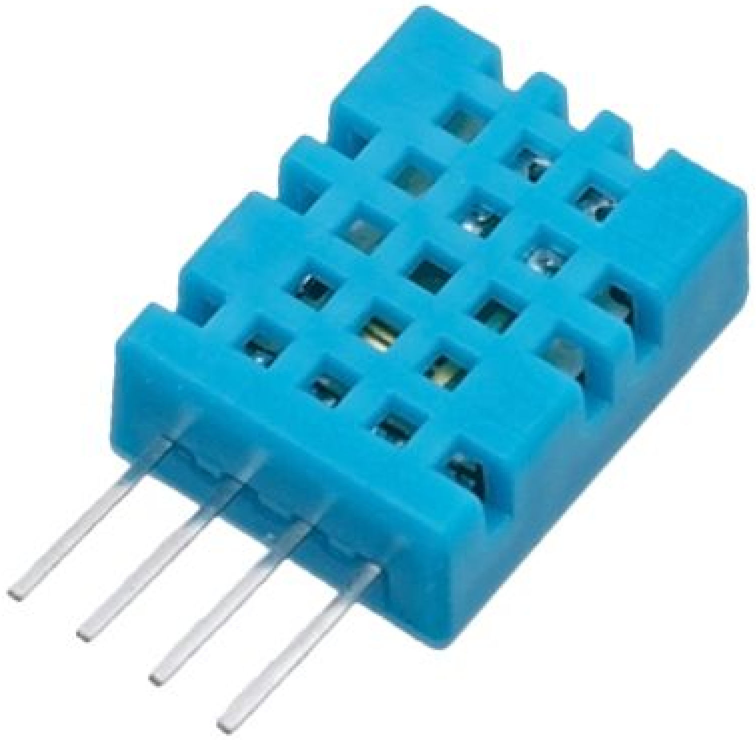
Components	Winning Model
Power Source	Outlet
Refrigerator	Koolatron P-85 Cooler 52-Quart
Sensors/Data Logger	Arduino based, DHT11, BMP180

Sensors

- DHT11 Sensors for detecting

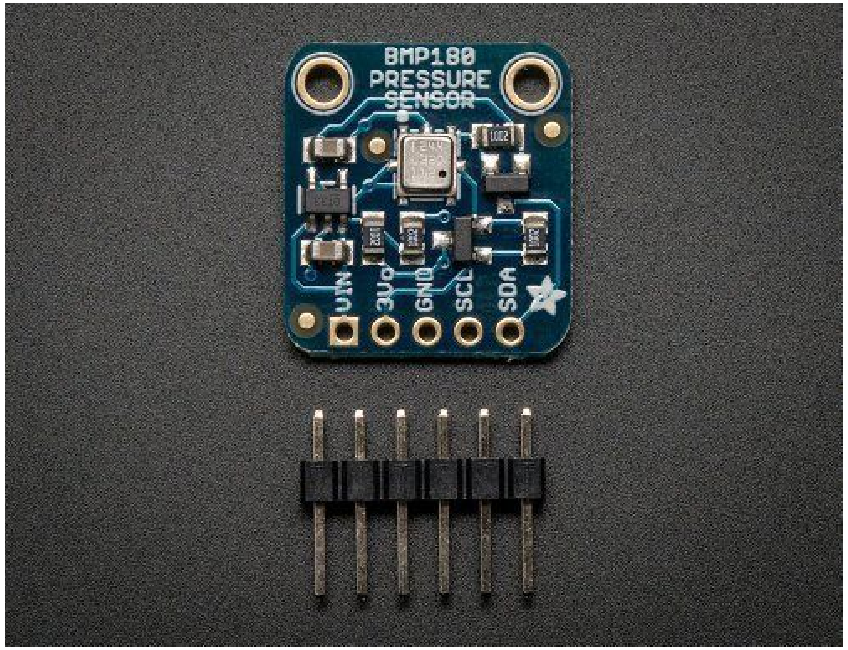
humidity and temperature.

- Can calculate dew point
- Calculations are a few seconds slow



Sensors

- Adafruit BMP180
- Senses temperature, pressure and altitude
- Does not sense humidity



Sensors

- Sensors at input and output
- Sensors will trigger fans
- Dew point will determine fan settings
- Sensors will auto log data to spreadsheets

Arduino Uno

- Simple programming language with lots of support
- Allows for easy use of different types of sensors
- Also, many members of the team are familiar with the board

Power

- Arduino can put out 3.3V and 5V
- Arduino can power fans
- Fridge will run off of outlet power
- Can turn on one, two or three fans depending on conditions

Cooling system

Igloo 40-Quart

Koolatron 52-Quart

Dometic 15 Quart

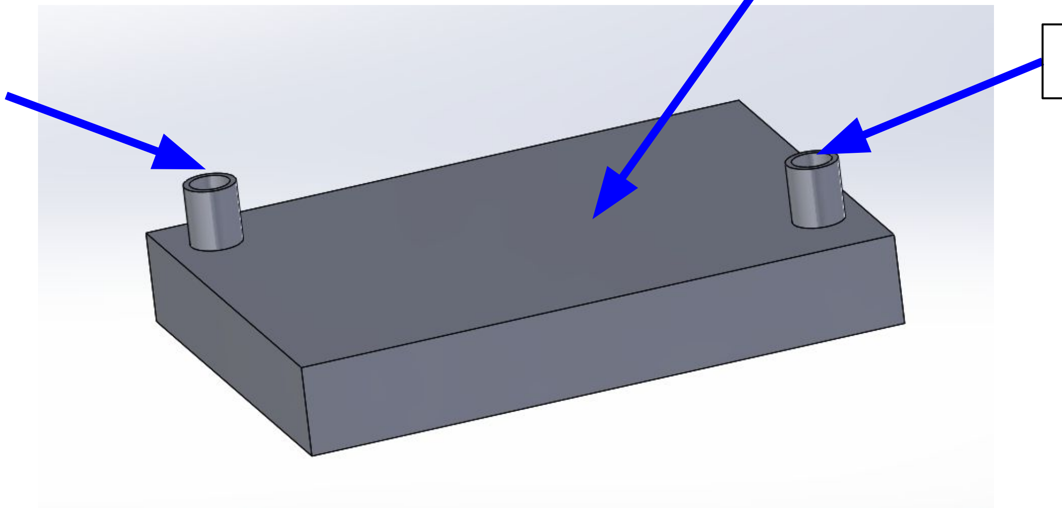
Cooling System

Koolatron 52-Quart Krusader Cooler

- **Cools 40°F below outside temperature**
- 17.4 pounds
- 20 x 15.5 x 20 inches
- 12V outlet with 120V AC adapter

Ambient air cycle

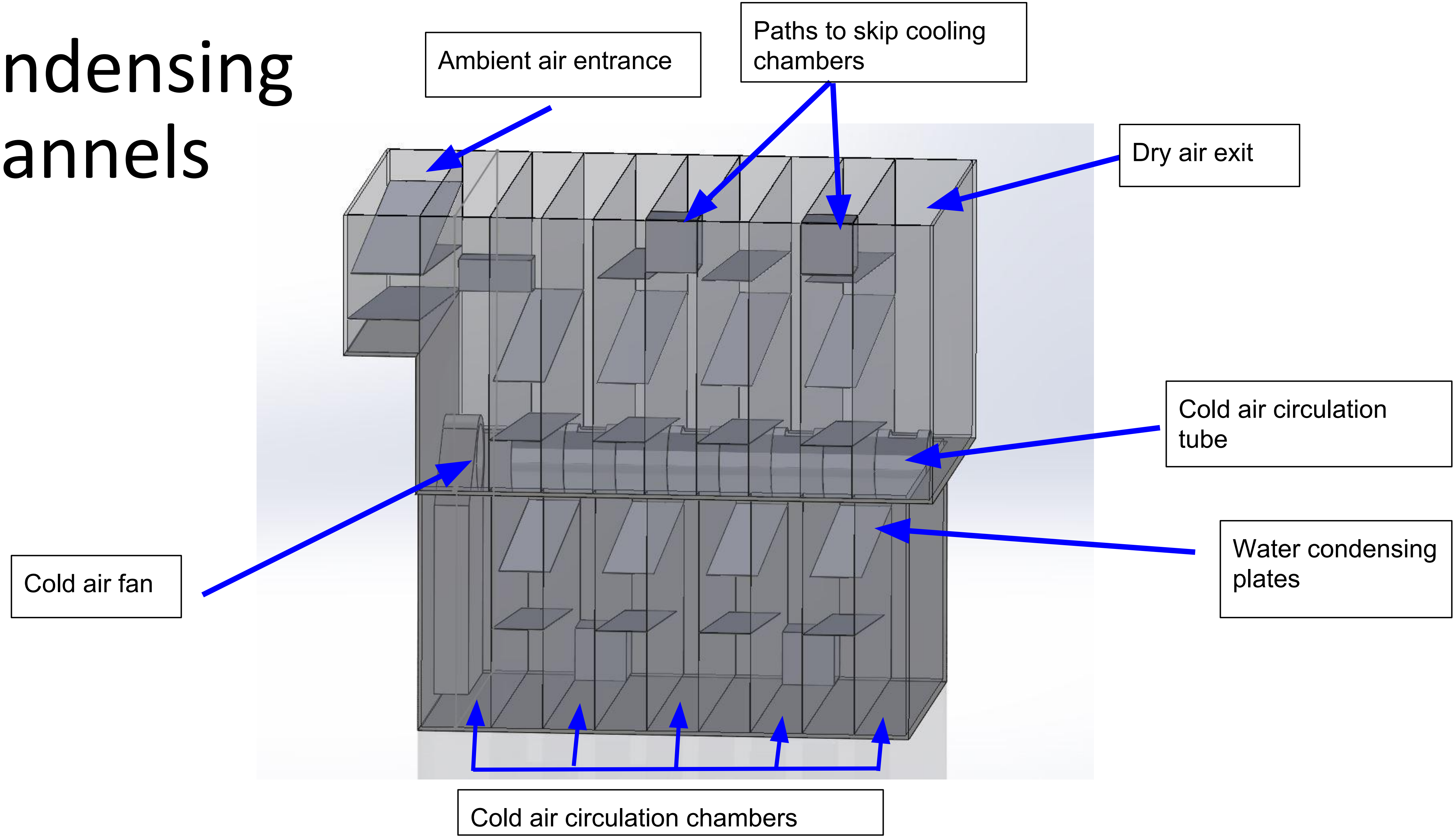
- Customized styrofoam lid
- Piping to input and output air
- Fans will be used to circulate air



Fans

- Will use a combination of fans depending on atmospheric conditions
- Fan speed will be controlled by arduino
- Air Flow: 57.67 CFM. Fan Speed - 1500 ± 10% RPM
- Fan to funnel to tube assembly

Condensing Channels



Manufacturing of Channels

- Aluminum sheet metal can be spot welded
- Specs for spot welding aluminum:
- Use sheet metal inserts

Electrode force:	3 to 5 kN
Weld time:	2 to 5 cycles (40-100ms)
Welding current:	22 to 28kA

Removing the Water

Options:

- Create a handle for the channels
- Use a pump
- Drill a drain into the cooler

Bill of Materials

Part #	Part Name	Qty.	Price
1	Portable Refrigerator	1	$169
2	Aluminum Sheets (3ft x 3ft)	2	$42
3	Arduino	1	$70
4	Fan (3 pack)	1	$11
5	Styrofoam Insulating Lid	1	$25
6	Pipe (PVC 1.5in diameter)	1	$7
7	Aluminum Pipe (2in diameter)	1	$16
			Total: $324

Conclusion

- The goal is to create an atmospheric water extraction device
- Used decision matrices and ranking of criteria to make choices
- Our design meets all of the constraints:
  - Sensing
  - Data logging
  - Cost
  - Power source
- The 3D representation of our drawing shows the air flow cycle
- Use sheet metal and spot welding to manufacture our design
- So far our customer is happy with our progress

References

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