
Bio-Inspired Design for Energy Efficiency (B.E.E.)

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Project Description

- What is the project?
 - To create a system or plan to increase the energy efficiency of NAU campus (or a building on campus) through a design inspired by nature.
 - System focused: HVAC
- Why is this project being done?
 - Previous: for Carbon Neutral 2020 initiative.
 - Current: Increase energy efficiency and awareness across campus.
- Whom is this project for?
 - The students and employees of NAU's Mountain Campus.

Potential Clients/ Sponsors

- AskNature.org
- NAU Facilities Maintenance
- NAU Green Fund
- Asknature and the biomimicry taxonomy
 - Gretchen Hooker & Ethan Smith
- Prometheus Solar
- Northern Arizona Wind & Sun
- Rooftop Solar
- 3D Systems (Portland Oregon)
- Social Behavioral Sciences West

Background and Benchmarking

State of the Art (SOTA)

- Radiative System
 - Radiative Panels collect solar energy to heat and pump fluid [1]
- Active Monitoring
 - Multi-Speed fans can reduce energy by 24-32% [2]
 - Controlling when heating/cooling reduces energy consumption by 20-60% [2]
- Ventilated Workout Suit
 - Vents actuated based on humidity and body temperature [3]

Existing products

- Active Solar Heating
- Boiler Heating



Figure 1: MIT Ventilation Suit [3]

Customer Needs

- CR's from client/ sponsor:
 - Needs to be based on nature
 - Must increase energy efficiency
- CR's we formed ourselves:
 - Must have a short pay off
 - Must provide the same services as current system
 - Must be easy to maintain
 - Must be space efficient
 - Must not generate excess noise pollution
 - Must have adjustable times

Engineering Requirements

- Bio-Inspired design
- 4-5 year pay off
- Equivalent thermal output
- Energy efficient
- Space efficient
- Ease in repair and maintenance
- Temperature Management
- Display Usage
- Mechanical System
- Noise Pollution

Schedule

TASK NAME	START DATE	END DATE	START ON DAY*	DURATION* (WORK DAYS)	TEAM MEMBER	PERCENT COMPLETE
Class						
Team Charter	9/1	9/10	0	9	All	100%
Staff meeting 1	9/17	9/17	16	0	All	100%
Presentation 1	9/17	9/24	16	7	All	100%
Website check 1	9/17	9/24	16	7	Hani	100%
Staff meeting 2	10/1	10/1	30	0	All	
Analyses Team memo	10/1	10/8	30	7	Taylor, Talon	
Preliminary Report	10/5	10/15	34	10	Kyle	
Staff Meeting 3	10/22	10/22	51	0	All	
Website check 2	10/15	10/22	44	7	Hani	
Analytical Reports Due	10/22	10/29	51	7	All	
Staff meeting 4	10/29	10/29	58	0	All	
Final Report due	10/15	11/22	44	38	All	
Full Prototype, BOM, and CAD package due	11/1	12/5	61	34	Taylor, Talon	
Website check 3	11/22	12/5	82	13	Hani	
Team						
Email potential client	9/1/2018	10/15	0	44	All	50%
Email potential sponsors	9/1	12/10	0	100	Taylor, Kyle	50%
Website	9/17	12/10	16	84	Hani	20%
Meetings	9/1	12/10	0	100	All	10%
Work on project twice a week	9/1	12/10	0	100	All	10%
Write Analyses	9/25	10/8	24	13	Kyle	
Write Analytical	10/8	10/22	37	14	Taylor	
Work on Report	10/8	11/22	37	45	Asll	
CAD and Prototyping	10/8	12/5	37	58	Talon	
Client and Sponsor						
TBD						
Client and Sponsor						
TBD						

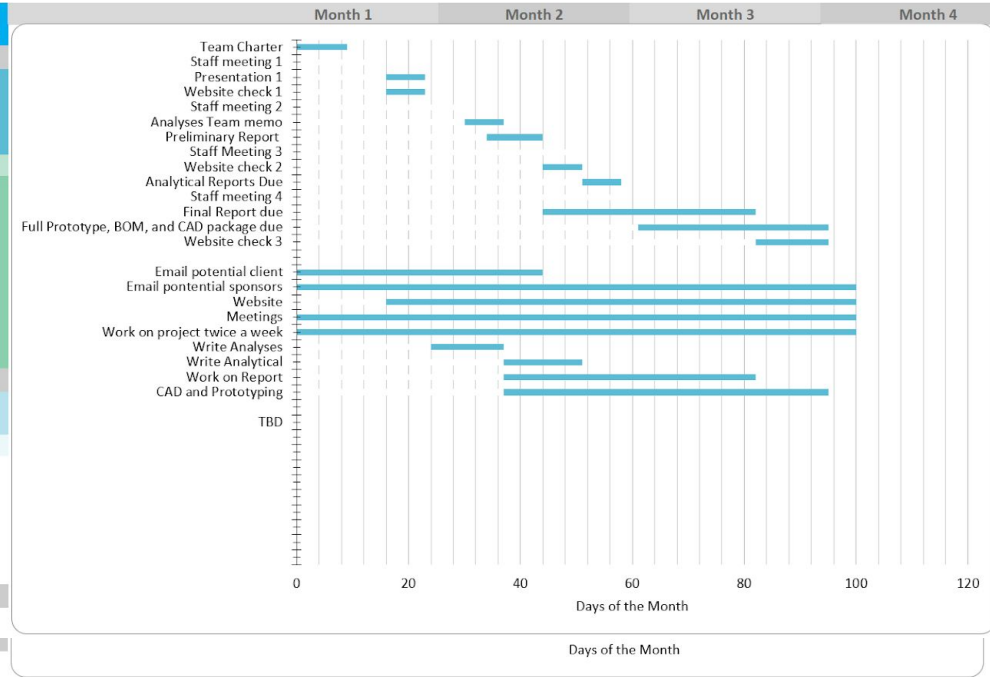


Figure 3: Tentative Gantt Chart

Budget

- Funds available for project:
 - Unfunded at this time
- Anticipated funds for project:
 - Analytical: None
 - Prototyping: Goal of approximately \$500
- Current and future expenses:
 - Current: None
 - Future: TBA

Future work

- What needs to be done?
 - Continue search for client and/or sponsor
 - Start brainstorming ideas and narrow down on a building to focus on.
- What should be done?
 - Keep looking for a client but put a drop dead date on looking for one before moving forward with current project idea.

Future Work Continue

- What does the future hold?
 - It is all unknown based on funding as the project unfolds.
 - Optimistic: Complete proposal and prototype for client and sponsors
 - Realistic: Unknown
 - Worse case: Continue analytical revisions

References

- [1] P. Patel, "Efficient Air-Conditioning Beams Heat Into Space", IEEE Spectrum, 2017.
- [2] Building. (2015, November 1). How Smart Buildings Save Energy. [Online]. Available: <https://www.buildings.com/article-details/articleid/19537/title/how-smart-buildings-save-energy>
- [3] J. Chu and MIT News Office, "Researchers design moisture-responsive workout suit," *MIT News*, 19-May-2017. [Online]. Available: <http://news.mit.edu/2017/moisture-responsive-workout-suit-0519>. [Accessed: 24-Sep-2018].

Questions?