energycanvas

Memorandum

TO: Stephen Tordoff
CC: Kimberly Lemieux, Mel Dundas, Wayne Mayes
FROM: Urban Fresh
DATE: September 21, 2018
SUBJECT: Renewable Automated Hydroponic System Proposal

1.0 Summary

The Urban Fresh technology is an intelligently automated hydroponics system that runs on renewable energy with integrated energy storage. It is valuable because the system can provide a reliable and resilient source of food and energy storage independent of the power grid, climate, or location. This will help to resolve the growing issue of food insecurity, especially in communities where power is expensive, unreliable, or non-existent.

2.0 Introduction

Food security is essential to human growth and peace of mind. Food insecurity is becoming more prominent as the world's population grows, and food demand along with it. Natural disasters, harsh growing conditions, and a continued globalization of the agriculture sector threatens the availability, affordability, and quality of food for all communities.

An estimated 124 million are currently facing a food crisis: an 11% rise since 2017 [1]. The primary causes being conflict and increasing climate shocks [1]. Between 2003 and 2013, natural hazards and disasters in developing countries affected more than 1.9 billion people and caused over USD 494 billion [2] in estimated damage. On average, agriculture accounts for 22% [2] of that damage, largely as a result of drought.

In Canada harsh climate and short growing seasons such as those in remote Northern communities renders basic food items unaffordable. 1 Kilograms of onions averages $2.15 [3] in Canada while it costs $5.36 [4] in Baffin. Even local urban communities have a growing demand for local food[5] that cannot be met. BC produces only 43% [5] of the vegetables it consumes resulting in a dependence on mass transport of food goods.

Hydroponics can resolve many of these issues by extending the growing season, improving crop resilience, and allowing the establishment of urban farms; however, standard hydroponic technology requires a constant source of energy, a large investment, and a specialized expertise. These systems are not compatible with post disaster situations where a power grid is unreliable, harsh northern climates where heating is too expensive, and local farms where an efficient and flexible system is an asset.

Our goal as Urban Fresh is to create a hydroponic system to help solve these problems. This will be the continued work from the summer of 2018 where one of our team members, Solomon Lindsay, worked for the Vancouver based renewable energy company, Energy Canvas, on the initial research and conceptualization of the Urban Fresh system.

3.0 Technical

The core objectives of Urban Fresh as a whole is to be:

- Renewable
- Flexible
- Engineered

To address these, our system will be fully DC and draw minimal power to be compatible with solar and energy storage. The system will be simple and modular so it can be applied to any hydroponics system, crop, or environment. Finally it will be intelligently automated so it can record data and make decisions to balance the resources available with the health of crops.

Given the short amount of time to complete this project, we will focus on three core components of the system: the plant monitor, the online database, and the control system. Focus on these three systems and the interconnecting software will create a valuable product that could be applicable to practically any physical hydroponic system with minor adjustments.

3.1 Plant Monitor

We will upgrade the current genesis model plant monitor into a practical device to measure crop temperature, humidity, moisture, light intensity, and record a photographic growth time lapse. It will be a compact device with built in sensors, display, and IoT connectivity. It will be programmed to record and upload sensor data, recognize and send alerts for problematic environmental parameters, and recognize when it is not connected to the network so it stores data for redundancy.

3.2 Online Database

We will create a custom online database and user interface to store, organize, and present crop data. It will allow remote monitoring of crops and control of crops. It will provide a comprehensive history of crop yield according to environmental parameters. It will also be designed to enable future recording of power supply and consumption data.

3.3 Control System

We will create a genesis model of the control system that will use plant monitor data to control the system ventilation, heat, light, and irrigation. It will be an adaptable system using relays and voltage dividers to control the power supply to any device. It will download crop data from the online database and directly from plant monitors for redundancy.

3.4 Challenges

The system must be built to be compatible with renewable energy in the future. The full system must be compatible with a DC power supply, use as little power as possible, and use as few different power levels as possible to minimize the number of converters. The full system should be designed to run off a low cost, 12V lead acid car battery or equivalent.

The system is being built to be flexible to all variety of environments, many of which will not have reliable internet or power. We will design the system with reliability and redundancy in mind so every system can work independent of the others.

The reliability will be especially important of the control system where higher power components will be used, and therefore it will involve a higher risk. The system will be designed with safety in mind and have fail safes to cut power in the case of emergency.

4.0 Management

4.1 The Team

'Urban Fresh' itself is a subsidiary of Energy Canvas in Vancouver, founded by Stephen Tordoff. The 'Urban Fresh' team is a group dedicated to developing the Urban Fresh hydroponic technology for Energy Canvas. The team consists of three third year electronics and computer engineering students at Camosun College: Pawan Kumar, Solomon Lindsay, and Varun Prabhakar. The Urban Fresh system was researched, conceptualized, and a genesis model of the Urban Fresh plant monitor was created, by Solomon and Stephen over the 2018 summer work semester at Energy Canvas. Given this connection to Energy Canvas, and the extensive experience we have had from working together as team for two years of engineering labs, courses, and projects, this team is ideal for developing the Urban Fresh technology.

4.1.1 Team Contacts

Pawan Kumar:
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Phone: 250-514-9001
Varun Prabhakar:
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4.2 Logistics

If possible we will work with Stephen Tordoff to purchase the necessary materials to advance the genesis plant monitor to a functioning prototype and assemble a prototype control system. All devices will be assembled and stored at Camosun College in the dedicated project room until the final system test. The final product will be tested as a feedback control system in a custom germination unit built at Camosun College, or it will be integrated into the established micro-greens farm at the Energy Canvas office in Vancouver.

4.3 Facilities

We will use the Camosun College labs for programming and assembly where all necessary equipment is provided. We will use the college print room for any small scale 3D prints necessary, and we will use the two Energy Canvas printers for any larger, multi-day prints necessary. All special equipment and supplies will be stored in the dedicated project room.

4.4 Schedule

Our proposed schedule is given as a Gantt chart in Index B. This is an early estimate and is subject to change, but it provides a buffer time of three weeks before showcase to finish any final touches and run a system test. In addition to this schedule, we will have weekly updates to schedule the weeks tasks on Monday and review the progress made on Fridays.

4.5 Responsibilities

Pawan Kumar

- Web Programming
- Microcontroller Programming
- Circuit Assembly

Solomon Lindsay

- Manager
- Client Liaison
- Documentation and Reports
- 3D CAD Modelling

Varun Prabhakar

- Microcontroller Programming
- Altium Circuit Modelling
- System Testing

4.6 Agreement

Should Stephen Tordoff be willing, all components and supplies for the Urban Fresh project will be funded by Energy Canvas and he will gain full ownership of the product at the conclusion of this project semester.

5.0 Financial

The parts list in Table 1 is an approximation of the total materials required to construct the full system, including two plant monitors and a control unit.

Table 1: Material Cost Estimate

Item	Model	Supplier	Manufacturer	Price	Qty	Total
Microcontroller	ESP32 Heltec	Amazon	Heltec	$37.00	3	**$111.00**
PCB	-	JLCPCB	JLCPCB	$2.00	1	**$2.00**
Camera	OV7670	Amazon	NJPower	$16.00	1	**$16.00**
Temp/Humidity	HIH7120	Digi-Key	Honeywell	$15.70	3	**$47.10**
Moisture Sensor	Capacitive	Digi-Key	DF Robot	$11.40	3	**$34.20**
Photocell	-	Supplied	-	$0.00	3	**$0.00**
Water Temperature	DS18B20	Supplied	-	$0.00	2	**$0.00**
Fan	-	-	-	$50.00	1	**$50.00**
Heater	-	-	-	$100.00	1	**$100.00**
Pump	-	-	-	$100.00	1	**$100.00**
					Total	**$460.30**

6.0 Conclusion

The Urban Fresh hydroponic system will be a unique and innovative project with a lot of potential for future development and application. It is an ambitious project, but we believe our team can complete the project on time and with great results.

We hope for approval of the proposed project by October 1st, 2018. We can be contacted through our project manager Solomon Lindsay at sol.lauder.lindsay@gmail.com

Reference List

[1] WFP United Nations. (2018). Global Report on Food Crises [Online]. Available: https://www.wfp.org/content/global-report-food-crises-2018

[2] FAO United Nations. (2015, May). The impact of natural hazards and disasters on agriculture. [Online]. Available: http://www.fao.org/3/a-i4434e.pdf

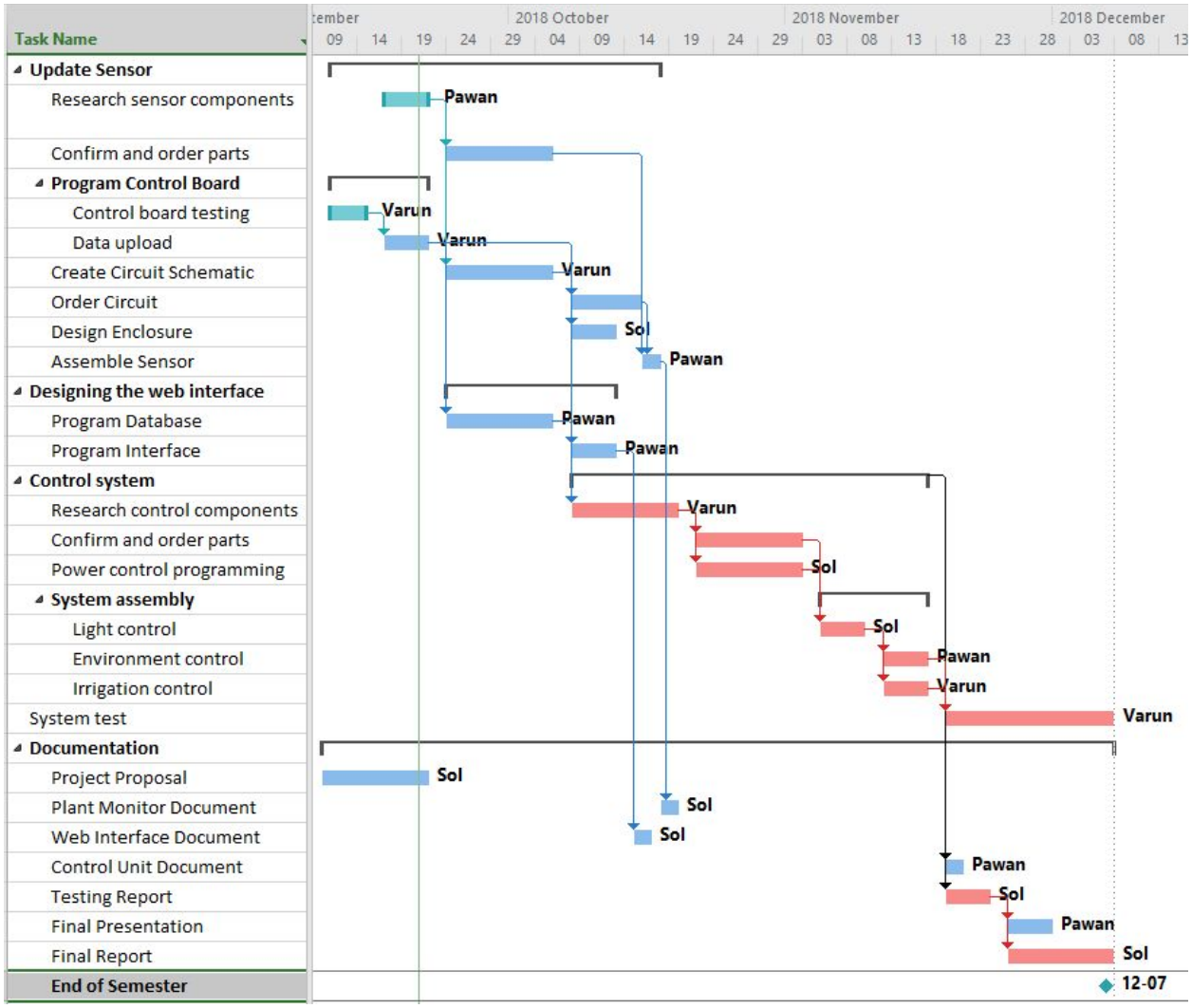
[3] Statistics Canada. (2018, August). Monthly average retail prices for food. [Online]. Available: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810000201

[4] Nunavut Bureau of Statistics. (2017, March). 2017 Nunavut Food Price Survey. [Online] Available: https://www.gov.nu.ca/sites/default/files/2017_nunavut_food_price_survey_-_price_comparisons_per_kilogram_and_litre_report_1.pdf

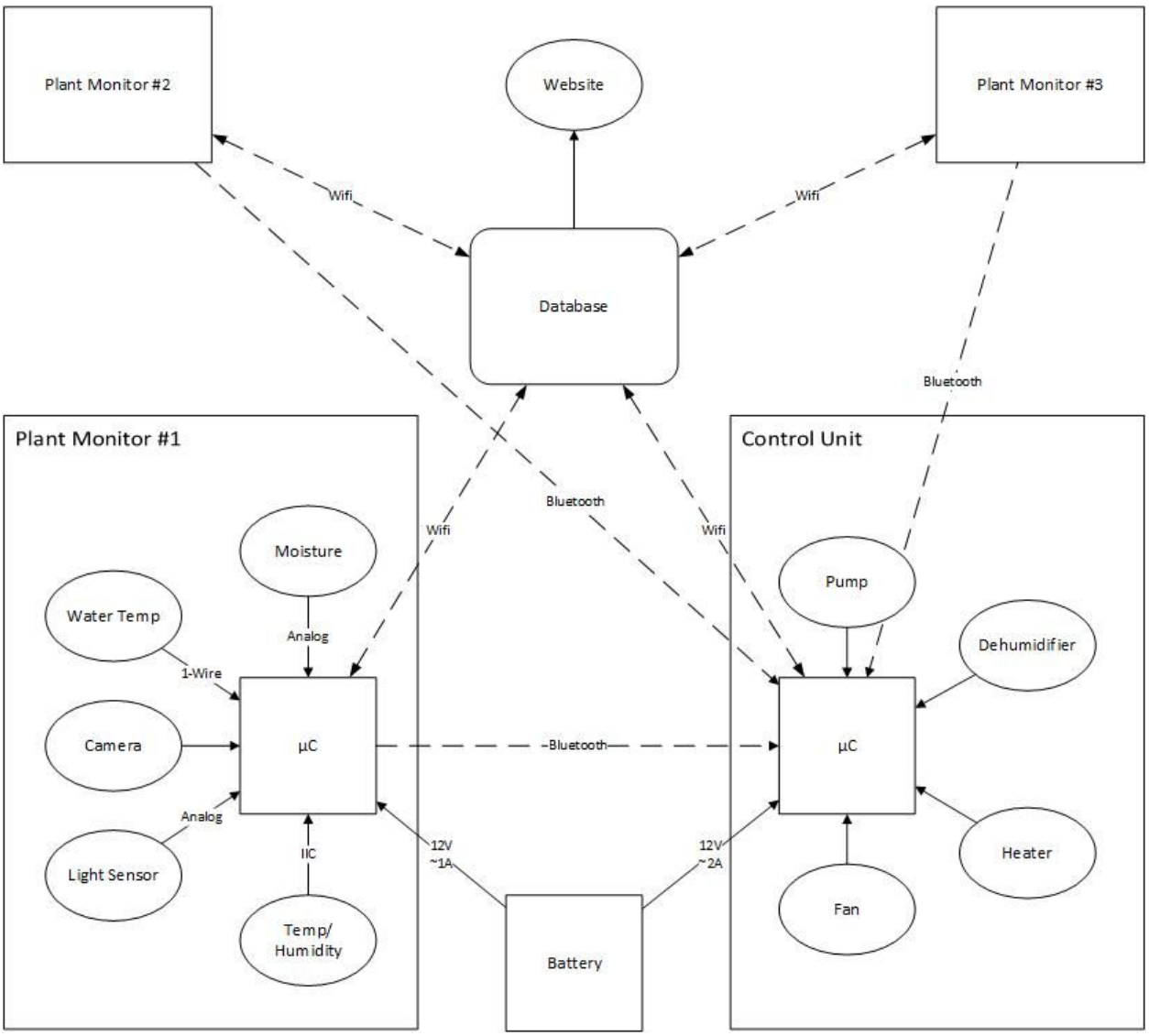
[5] Vancouver Economic Development Commission. (2016, May). The economy of local food in Vancouver. [Online]. Available: http://www.vancouvereconomic.com/wp-content/uploads/ 2016/07/the-economy-of-local- food-in-vancouver.pdf

[6] B.C. Ministry of Agriculture and Lands. (2006). B.C.'s Food Self-Reliance. [Online]. Available: https://foodsecurecanada.org/sites/foodsecurecanada.org/files/BCFoodSelfReliance_Report.pdf

Appendix A - Timeline



Appendix B - Project Diagram



Appendix C - Example Graphical Interface