
Senior Design 1 Initial Project Document

8 June 2018

The ParaSolar Experience



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Narrative

Technology is undoubtedly becoming an indispensable component to most humans' lives. As time progresses, an immediate observation can be made; adults and children are spending more time on their phones or tablets, and less time outdoors in natural environments. This observation initially seems like it should have little to no effect on the well-being of the person. Staying indoors means one would be less susceptible to contracting viruses or being endangered by the element, right? While this logic appears to be soundproof, there are actually many reasons as to why these assumptions are false.

Studies have shown that lower levels of sunlight exposure can cause lower "levels of certain mood-regulating brain chemicals. [Declines of which can] trigger a form of clinical depression." [1] A similar report relating to this issue spoke about the negative health effects due to indoor air humidity and quality, such as sensory irritation in eyes and upper airways, and a noticeable decrease in work performance, sleep quality, virus survival, and voice disruption. [2] Now more than ever before, children are missing the experience of being outdoors, and are instead remaining indoors glued to whatever piece of technology they happen to be enraptured with presently. In summation, a quote taken from a study by Wells and Evans, "Time spent in contact with the natural environment has been associated with better psychological well-being, superior cognitive functioning, fewer physical ailments, and speedier recovery from illness." [3]

Now the question is, upon being equipped with the knowledge of the plethora of negative impacts staying indoors has on the body and mind, why are people remaining inside? What is the cost of moving to the outdoors amongst the shining light of the sun and the cool gentle breeze of a non-air-conditioned open space? The answer to this question is convenience; convenience is the cost. People do not want to leave the convenience of having a comfortable and secure place in which they can listen to their music, charge their smartphones, and stay connected with friends and loved ones through their various social media apps. Here is where the issue lies, and this is where our project is going to make its impact. Our product is going to deliver the ease and comfort of staying inside to the outside world. By bringing the indoor conveniences to the outdoors, people will have no excuse to, nor will they want to stay cooped up within walls. We plan on achieving this task by equipping what would be a common beach umbrella with all the necessary tools to achieve maximum convenience. Those being a charging station for the user's devices, a bluetooth speaker for listening to their music, consistent updates on pertinent weather information, and a security system to keep everything protected while the user relaxes.

Goals & Objectives

The goal of this project is to make it as easy as possible to move outdoors while still maintaining the ease of being indoors. To make the project as easy as possible to utilize, it must be self-sustaining, provide wireless communications containing helpful information about the environment and updates about the device itself. The product must also ensure a secure environment for the devices while the user enjoys the outdoors, as well as provide entertainment and ultimate connectivity with the users handheld devices on multiple platforms. The resulting product of this project should be low-cost compared to other similar products and it should be lightweight and portable. While there have been products similar to this project, there has never been one done in quite the same way. However, this is by no means an impossible task, there is a large pool of products to use as a resource and guide in the assembly of this project. For example, the Bluetooth Cooler and Sound System by Sharper Image incorporates a few of the features that are going to be integrated into this design. The most influencing of which being the bluetooth speaker that is able to withstand harsh environmental conditions, such as sand and water. Additionally, the Solarella by Rostislav Rusinov and Pavel Nenkov applies a similar design, sans an assortment of key features utilized in this projects composition. The simplicity of this design can provide helpful information on maintaining a sleek and portable product.



Figure 1. Similar product, Solarella, by Pavel Nenkov

Specifications and Requirements

The table below (Table 1) outlines measurable and verifiable requirements and specifications for the project.

Table 1. Specification and Requirements for the ParaSolar Experience

1.0	This system shall cost less or the same as similar products range between \$130 and \$500, (ours < \$200)
1.1	This system shall weigh the same as similar products (10 lbs and 18 lbs. (ours < 12 lbs?))
1.2	Response time between software and hardware for security system shall be less than 5 seconds
1.3	Dimensions when closed will not exceed: 8ft in length and 1-foot in diameter
1.4	Dimensions when open will not exceed: 8ft in length and 8 feet in diameter
1.5	Voltage and Current output of USB ports (2) will be at least be 5V and .7A
1.6	Measures external environmental no greater error than $\pm 2^\circ$ temperature and $\pm 5\%$ humidity readings

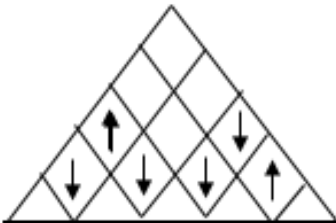
The bulleted list below outlines project requirements.

- The system shall receive user input via Bluetooth
- The system shall utilize a microcontroller to interface between components
- The system shall be resistant to water.
- The system shall have the ability to play user audio input via high quality speakers
- The system shall have a display with temperature, battery life, and other relevant data
- Simple, customizable user interface
- Easy and quick two way Communication with MCU
- The system shall be resistant to small particles (Sand or Dirt)
- The system shall operate in a reduced power mode after a standby time

House of Quality

To help develop the project concept, tradeoffs and marketing requirements must be considered. Understanding these two developmental properties help identify what can and will be accomplished in making the concept a reality. Below these properties are classified and compared in the matrix:

- ↓ = Negative Correlation
- ↑ = Positive Correlation
- ↓↓ = Strong Negative Correlation
- ↑↑ = Strong Positive Correlation
- + = Positive Polarity
- = Negative Polarity

Direction of Improvement						
		4	5	2	3	1
Engineering Requirements	Importance (1-5)					
		Dimensions	USB Power Output	Low power consumption	Sensor Accuracy	Security Response Time
Marketing Requirements		-	+	-	+	-
Sound Quality	+	↓		↓		
Portability	+	↑			↓	
Cost	-	↓	↓↓	↑↑	↓	↓
Entertainment value	+	↑	↑	↓		
Security	+	↓		↓	↑↑	↑↑
User Interface	+	↑		↓	↑	
Targets for Engineering Requirements		<12lbs; CL: 8ft/1ft; OP: 8ft/8ft	>5v and >.7A	<20Wh	<5% hum. & ±2°F	<5 seconds

Design Block Diagrams

Hardware Block Diagram

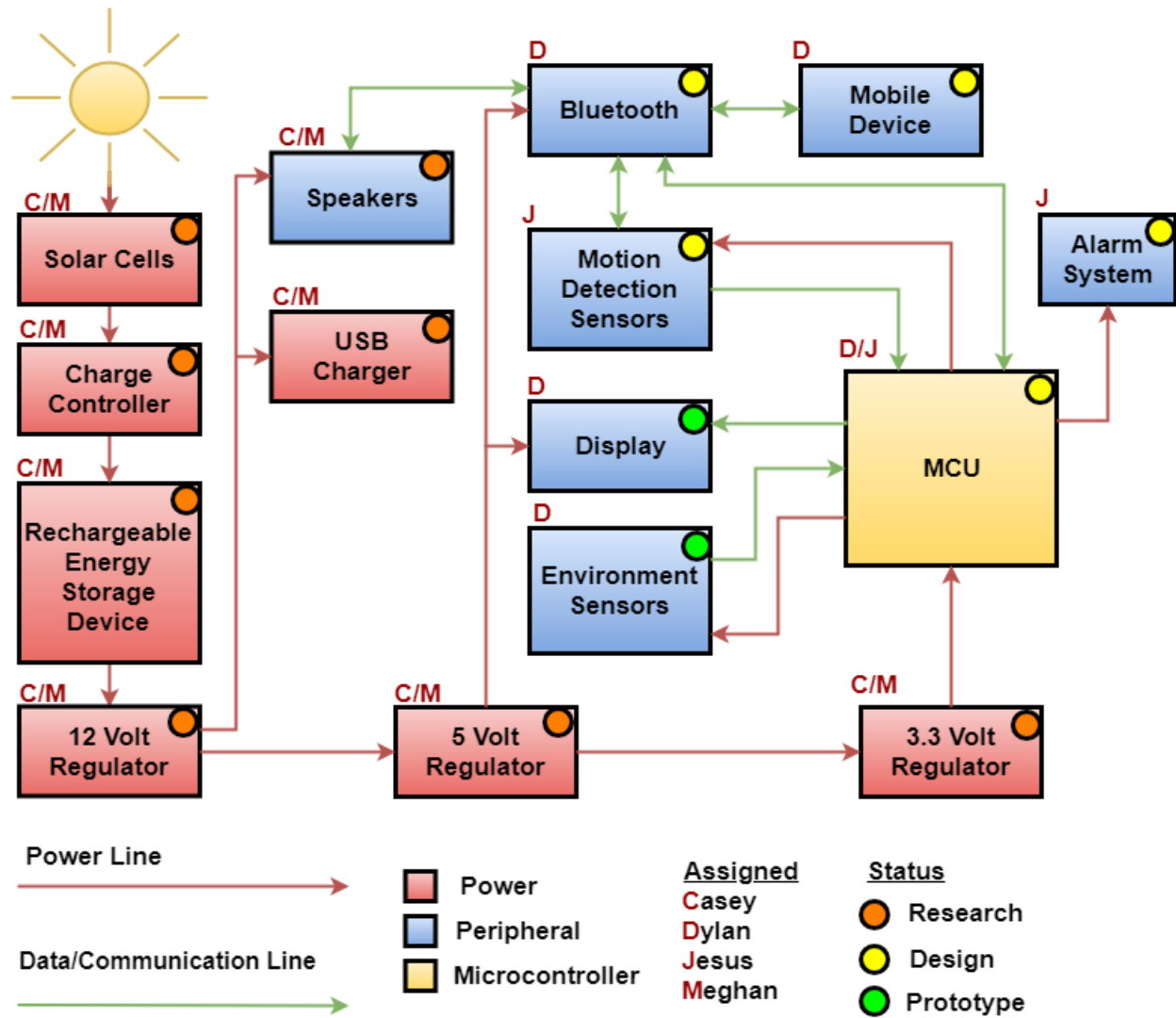
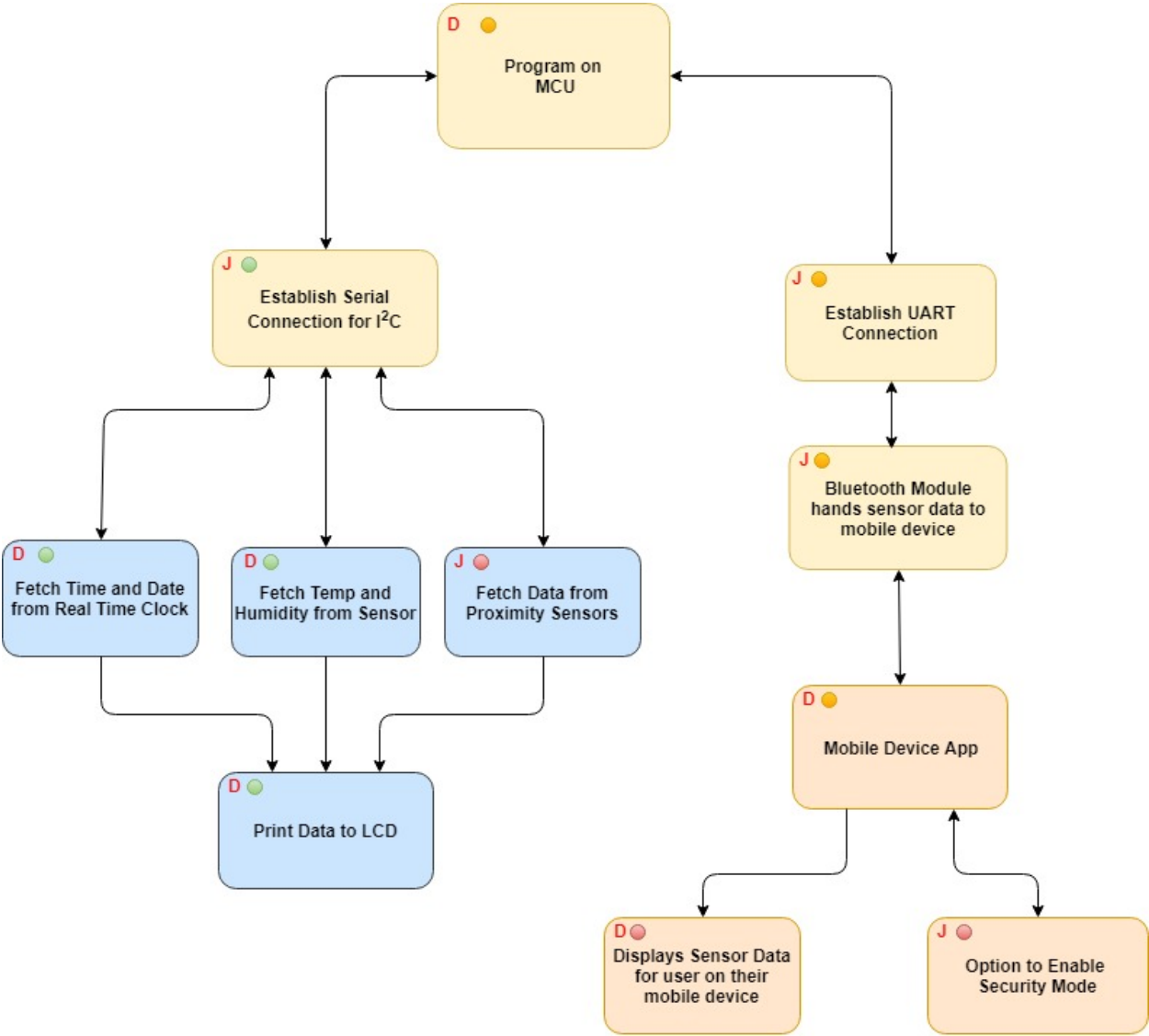


Figure 2. Hardware Composition and Structure

Software Block Diagram



- MCU and Communication
- Sensors on I²C
- Mobile Application

Assigned
Casey
Dylan
Jesus
Meghan

Status
Research
Design
Prototype

Figure 3. Project Firmware Flowchart

Project Budget

The project budget for the design is outlined below in Table 2.

Table 2. Project Budget for Senior Design

Item	Quantity	Price Estimate (total)
Beach Umbrella	1	\$45
MCU	1	\$5
Solar Panel	5-6	\$50
LCD Display	1	\$12
Speakers	3-4	\$25
LEDs	10	<\$5
Temperature and Humidity Sensor	5	\$8.99
Proximity Sensor	5	\$9.50
Bluetooth module	1	\$5.65
Custom PCB	?	\$12
Energy Storage Device	1	\$45
Waterproof/Particle materials for encasement	N/A	Free
USB Type A Female Ports	2	\$3
Resistors, Capacitors, and ICs	N/A	<\$4
Trips to the beach?	Many	As much as it takes

Total: \$198.15 - \$230.15

Project Schedule

The milestones and respective deadlines are outlined below.

<u>Deadline</u>	<u>Milestone</u>
6/8/2018	Divide and Conquer Report
6/13/2018	Half hour meeting with Dr. Wei
6/15/2018	Update Divide and Conquer
6/22/2018	Research and document detailed design and parts
6/23/2018	Build user interface for display
7/2/2018	Finalize fist design and parts
7/6/2018	60 pg draft
7/8/2018	Interface sensors with MCU
7/9/2018	2nd Half hour meeting with dr. Wei
7/10/2018	Interface screen and display sensor data
7/10/2018	Design housing for mcu and sensors
7/11/2018	Integrate system with wireless communication to mobile device
7/12/2018	Update 60 pg draft
7/20/2018	Build android application
7/20/2018	100 pg submission
7/30/2018	Final Report Submission
8/3/2018	Design PCB and Order Parts deadline
8/31/2018	Build project on designed initial PCB (start 17 august)
9/19/2018	Integrate components and housing
10/26/2018	Final testing and revisions

Sources

- [1] SPECIAL REPORT. WARDING OFF THE HIBERNATION EFFECT: How to stay healthy, happy and active until the robins return., Consumer Reports on Healthy, Pg. 8 (November 2007)
- [2] Wolkoff, Peder. "Indoor Air Humidity, Air Quality, and Health - An Overview." International Journal of Hygiene and Environmental Health, vol. 221, 2018, pp. 376–390.
- [3] Wells, Nancy M, and Gary W Evans. "NEARBY NATURE: A Buffer of Life Stress Among Rural Children." Environment and Behavior, vol. 35, no. 3, May 2003, pp. 311–330
- [4] Nenkov, Pavel. "Solarella: The Solar Umbrella." Indiegogo, 1 Dec. 2014, www.indiegogo.com/projects/solarella-the-solar-umbrella#/.
- [5] "Bluetooth Cooler and Sound System." The Sharper Image, The Sharper Image.