



UNIVERSITY OF MISSOURI – COLUMBIA
DEPARTMENT OF ELECTRICAL ENGINEERING & COMPUTER SCIENCE

Outdoor Solar-Powered Lighting Installation and Acoustic Mosquito Repellent for Unpowered Outdoor Structures

ECE CAPSTONE PROJECT – PROPOSED IMPLEMENTATION

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Style Definition: Figure: Space After: 4 pt, Line spacing: single

Style Definition: Grader Feedback

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Commented [JDF2]: This report has two tables, which should be listed herein.

Table of Equations

No table of figures entries found.



Commented [JDF3]: Remove empty tables from the front matter.

Do you have textbooks that have empty tables like this in the front matter? No, right? So it's evident that empty tables like this should be removed from the final draft version of a professional report.

Proposed Implementation

This report describes the possible implementations we considered for this project, and we identify and describe our selected/proposed implementation for this project. Each group member's work assignments and responsibilities for the proposed Capstone project are summarized at the end of this chapter.

Ideation

In this section we describe the implementations, features, etc. the group considered during brainstorming sessions where the group members ideated possible solutions / implementations of the project. The level of detail provided herein is limited to concept diagrams, functional block diagrams, and software architecture diagrams. Implementation details are not provided herein.

Brainstorming

By Nicholas Erickson

For our capstone design project, our group wanted to focus on utilizing a renewable energy source to help solve a problem or improve an existing product. After group discussion of various project proposals, we decided to use solar energy to power an outdoor light-emitting-diode (LED) strip to be used for social gatherings. When contemplating different ways to implement our idea, we brainstormed that it would be a nice addition to attach a mosquito repellent tone to deter mosquitos while enjoying our product outdoors. To add an exciting element to our product, we decided to include the option to use a music mode to pulse to music audio signals. When thinking about the practicality of our product, we wanted the user to have the ability to remotely control the LED display fully remotely. We decided that the best way to

Commented [JDF4]: light-emitting diode
There is no hyphen between "emitting" and "diode".

implement remote functionality would be to design a mobile app with an interface for the user to control the LED output.

Proposed Implementation

Our proposed implementation for our capstone project is to power an outdoor LED strip with a solar charged battery. Our LED strip will be remotely controlled through a Bluetooth app with settings to change the colors and modulate the outdoor music. Additionally, our device will be attached with a mosquito repellent circuit.

Product Concept Diagrams

By Matt Soehngen

The ~~modified gazebo concept diagram shown~~ in Figure 1 shows a modified gazebo with the intended locations of the solar panel, rechargeable battery pack, controller, and lighting strip on a gazebo. The controller will be communicating with the lighting strip, repellent tone circuit, Bluetooth module, and audio sensor, and will be connected between the battery and the lighting strip.

Grader feedback

* Good job on your improvements to Figure 1, Matt.

* Page layout. When a figure is too large to fit at the bottom of the current page, it's okay to position that figure at the top of the next page, as you've done. What you don't want to do is leave a big, unfilled gap of whitespace at the bottom of a page, as was done here. Instead, move the heading "Functional Block Diagrams" and the paragraph that follows it from page 3 into this blank space on page 2. Next, reposition Figure 2 so it appears below Figure 1 on page 3, resizing Figure 1 or Figure 2 or both, as needed, to ensure both figures and their captions fit on one page.

* Formatting. FWIW, the document template I provided defines a formatting style named **Figure** that consistently and correctly formats paragraphs that have figures added. After you add a figure to a paragraph, select the figure (or better, select the entire line where a figure resides) and then apply the **Figure** style to that line:

Word's RIBBON BAR > HOME tab > STYLES gallery > Figure

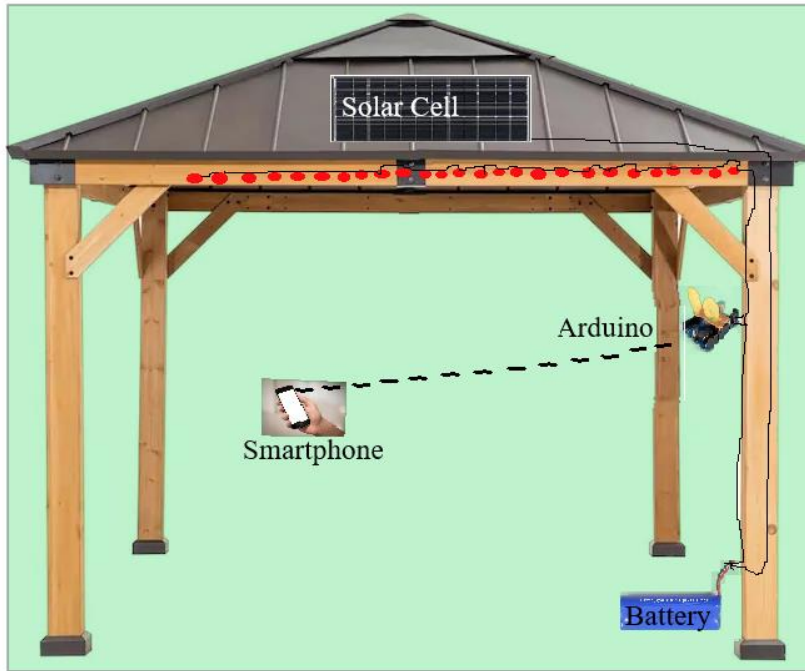


Figure 1. Product concept diagram showing intended product installation method

Functional Block Diagrams

By Sterling LaBarbera

Figure 2 is the ~~basie~~ functional block diagram for this lighting system. The solar power unit is separable but will be designed specifically for this lighting system. The lighting system uses LED strips for the actual lighting and ~~an Arduino~~ a controller. User interface is through an app, and the user's device connects using Bluetooth. There is also an ~~A~~audio sensor for visualization options and a mosquito repellent circuit.

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Commented [JDF5]: This report has one functional block diagram, not multiple functional block diagrams.

Commented [JDF6]: In this description, don't use/add identifiers that do not appear in Figure 2.

Commented [JDF7]: *audio* is an improper noun, and therefore is not capitalized.

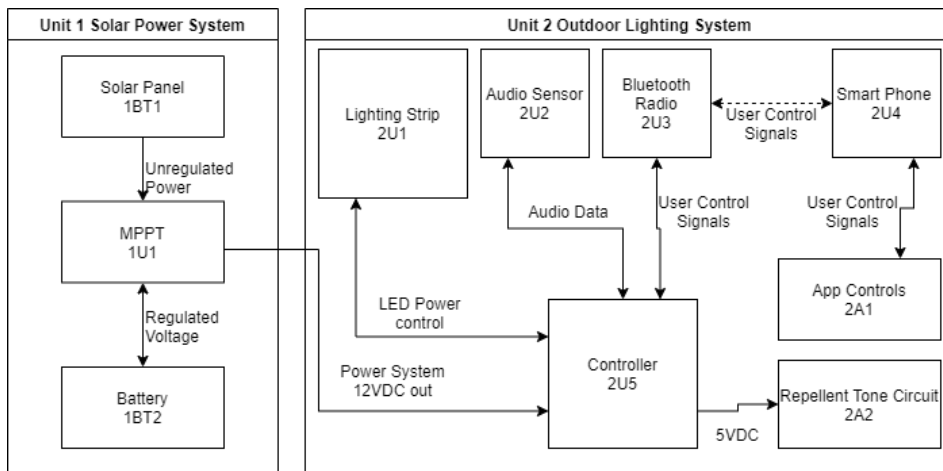


Figure 2. Functional Block Diagram for the proposed project.

Grader feedback on Figure 2

* Good job on your revisions to figure 2.

* The SMARTPHONE element should be a stand-alone element; it is not an element that you are creating and building into UNIT 2. If you purchase this product at Best Buy or Home Depot, you would not find a SMARTPHONE in the packing box along with UNIT 1 and UNIT 2. The SMARTPHONE is a stand-alone element that the customer provides, and therefore the SMARTPHONE should be displayed outside UNIT 1 and UNIT 2.

* Two different signal paths are labeled **USER CONTROL SIGNALS**. When you assign multiple signal paths the exact same label 'X', you are indicating that those multiple signal paths are in fact the same signal path (they are one signal path); they are not separate / distinct signal paths.

* The reference designation **A*** describes a "separable assembly" that is realized as a physical assembly constructed from basic parts like resistors, capacitors, integrated circuits, solder, circuit boards, etc. In Fig. 2, is **APP CONTROLS 2A1** realized as a physical assembly that someone in your group will construct from basic parts? If not, it should not be shown on this figure.

* On the signal path labeled **POWER SYSTEM 12VDC OUT**, remove the word "OUT" as it is redundant; it is self-evident from the directed line segment (a line with an arrowhead at one end) that this signal is coming "out" of the MPPT.

* Insert a [non-breaking space](#) (and preferably a narrow non-breaking space U+202F) between a number and its units: 12 VDC (12<NBSP>VDC) and not '12VDC'. Likewise, 5 VDC (5<NBSP>VDC), not '5VDC'.

Commented [JDF8]: *functional block diagram* is an improper noun, and therefore is not capitalized. Of course, in this case the word *functional* appears as the first word in a sentence, and therefore that word should be capitalized.

Also, do not use Title Case Capitalization for caption text; write caption text as an ordinary sentence.

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Unit 1 – Solar Power System

The Solar power system is composed of a solar panel to generate power, a maximum power point tracker to regulate the output signal, and battery to store the electrical energy. Unit 1 ~~will provide~~s power to Unit 2. The battery ~~will charge~~s during the day via solar panels mounted to the roof of the structure.

Commented [JDF9]: Use present tense verbs as your preferred verb tense. Use future tense verbs—e.g., will—only when describing some event that happens in the future (but not the immediate future).

1BT1 – Solar Panel

This will be a purchased solar panel attached to 1U3 via its provided wiring.

1U1 – Maximum Power Point Tracker

The maximum power point tracker (MPPT) will also be purchased due to complexity. It provides regulated output from the unregulated Solar panel. It also functions with the battery as a charger.

1BT2 – Battery

The battery is purchased and stores electrical energy for nighttime operation.

Unit 2 – Outdoor Lighting System

Our Lighting installation will run for up to 4 hours from Unit 1's fully charged battery. There will be app control for different light settings and intensities, and any Bluetooth capable smart device will be able to use the app. This unit will also feature a mosquito repellent circuit that produces a high frequency audio tone.

2U1– Lighting Strip

We will be purchasing LED strip lighting with color/intensity control to allow our software features to function.

2U2 – Audio Sensor

A simple audio sensor will provide input for the visualization software to modulate the lighting with music. This will be a purchased sensor compatible with the Arduino.

2U3 – Bluetooth Radio

A Bluetooth radio attachment for the Arduino controller. It will provide wireless communications with user smart devices

2U4 – Smart Phone

The user's smart device will have the app and control the system via Bluetooth.

2U5 – Controller

The controller will consist of an Arduino running custom software that can modify the lighting with various audio from the environment via the sensor.

2A1 – App Control

This app will have various controls for intensity, color, audio synchronization, and power for the full system and separately for the repellent circuit and the lighting. It will connect via Bluetooth.

2A2 – Repellent Tone Circuit

We will build and attach a circuit that emits a high-pitched tone known to repel mosquitos. It will be controlled via the app software as well, but is only an on/off element.

Software Architecture

By Nicholas Erickson

~~We will develop a mobile app architecture (Figure 3)~~ Figure 3 shows the proposed software architecture for the mobile app that ~~will be used to send~~s signals to the hardware

Commented [FJD10]: Start here on Friday 9/25

controller (Figure 2). The app ~~will contain~~ provides an interface with options to change the color of the LEDs, flash the lights, and turn on and off the music mode to strobe the LEDs. Our hardware controller ~~will be~~ is connected to a feedback loop (Figure 3) that ~~will contain~~ s an audio sensor ~~in order to that~~ receives input signals and ~~reacts~~ to the audio.

Hardware Controller and Mobile App Architecture			
LED Output Management		Remote Connection	User Preferences
GPIO Output	Feedback Loop Sensor	Bluetooth Connection Manager	User Preferences and Settings

Figure 3. Software architecture for the CONTROL assembly 2U5 (see also Figure 2).

Commented [JDF11]: Confusing. What do you mean by “input signals”? What information is conveyed, and where is the information coming from?

Commented [JDF12]: Reacts how, in what way?

Grader’s feedback

* **Nonstandard (user-defined) reference designations.** When you invent your own reference designations like MAA* and GPO*, the reader expects you to define those designations before they are used in the report. In the report, provide a subheading such as “Software Reference Designation Definitions” and under that heading list and explain each of the reference designations you are about to use. **After** the custom reference designations are defined, you can subsequently use them in headings, subheadings, written prose, tables, etc.

* The software elements shown on the bottom row of figure 3 represent input/output signals, and those blocks should exactly correspond to the input/output signals at CONTROL assembly 2U5 in Figure 2. The bottom row in Figure 3 should have blocks labeled LED POWER CONTROL, AUDIO DATA, and USER CONTROL SIGNALS.

* The reference designations mentioned in the sections below should also be displayed on figure 3, just as reference designations are shown on each of the functional blocks in the functional block diagram figure.

* In Figure 2, MPPT assembly 1U1 is not a CPU that executes your software, so its use below is improper— 1U1MAA1, 1U1GPO1, etc. Each software reference designation should indicate the assembly in Figure 2 that executes that software. For example, CONTROL assembly 2U5 is a CPU that executes software. Likewise, the SMARTPHONE is a CPU that executes software.

* As stated in the handout for this writing assignment, a separate software architecture diagram is required for each CPU. Each diagram models the software that executes on a specific CPU. This project has two CPUs: the user’s SMARTPHONE and CONTROL assembly 2U5. Therefore, the report should provide two separate software architecture diagrams: one software architecture diagram that models the software on the user’s SMARTPHONE, and a second software architecture diagram that models the software for CONTROL assembly 2U5.

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1U1MAA1 – Mobile App Architecture

The mobile app architecture will have a mobile interface that will send signals to the controller based on user input.

1U1GPO1 – GPIO Output

The GPIO (General Purpose Input Output) output ~~will be set to high or low~~ is a digital logic signal that specifies (what information?) and a different wavelength based on the desired color will be sent to the controller. Additionally, the GPIO output will depend on the input mode and the feedback loop for the music mode.

Commented [JDF13]: ??? Digital signals do not have a wavelength λ .

1U1FLS1 – Feedback Loop Sensor

The Feedback Loop Sensor will detect the input of the audio sensor and send a signal to pulse the output GPIO.

1U1BCM1 – Bluetooth Connection Manager

The Bluetooth Connection Manager will determine if the mobile device is connected to the controller where the mobile app will be able to communicate with the controller.

1U1UPS1 – User Preferences and Settings

User Preferences and Settings will read and save the user preferences for the mobile app.

Work Assignments

Grader's feedback

* I'm assuming Nicholas wrote this section. (This section has no byline, and the most recent byline has Nicholas' name.)

* Chapter headings and subheadings are always followed by written prose, never by a display element such as a figure, table, equation, etc., as was done here (this heading was immediately followed by a table).

* **NEVER** insert a display element into a document without also writing something to describe or explain to the reader the information you are attempting to convey / communicate via the display element.

* Each display element must be explicitly mentioned at least once in the written prose (e.g., Table 5, Figure 9). Tables 1 and 2 are not mentioned anywhere in your written prose.

* **ALWAYS** use Microsoft Word's built-in document automation tools to create and apply captions to their respective display elements. **DO NOT** manually type caption names and numbers (e.g., Table 1), as was done here, because doing so **guarantees** Microsoft Word will not find your captions, which **guarantees** Microsoft Word will not correctly populate the List of Illustrations, the List of Tables, the List of Equations, etc. in the report's front matter. To properly create and attach a caption to a display element (or to anything you want), do the following:

* First, select the item that you want to attach the caption to—e.g., select the entire contents of your table, or select your figure, etc.

* Next: Word's RIBBON BAR > REFERENCES tab > INSERT CAPTION

* On the CAPTION dialog box,

* select the desired label type (Figure, Table, Equation, etc.)

* select the correct position (above for tables, below for figures and equations)

* click OK

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Table 1. Group Member Assignments: Unit Assemblies

Assembly Reference Designation	Assembly Name	Commercial Off the Shelf? (COTS?) ¹	Assigned To
2A2	Repellent Tone	N	Matt Soehngen
2A1	Smartphone Bluetooth App Connection	N	Nicholas Erickson
2U1	Lighting Strip	Y	Matt Soehngen
2U2	Audio Sensor	Y	Sterling LaBarbera
2U3	Bluetooth Radio	Y	Nicholas Erickson
2U4	Smart Phone	Y	Sterling LaBarbera
2U5	Controller	N	Nicholas Erickson
1BT1	Solar Panel	Y	Sterling LaBarbera
1BT2	Rechargeable Battery	Y	Sterling LaBarbera
1U1	Maximum Power Point Tracker	N	Sterling LaBarbera

Commented [JDF14]: Remove from this table anything that is not a physical assembly. For example, is 2A1 as a physical assembly that Nicholas will design and construct with basic electronic components? If not, then 2A1 doesn't belong in this table, and it should be removed from figure 2.

Commented [JDF15]: Caption text. Write captions as ordinary sentences.

Do not use Title Case Capitalization when writing caption text.

Commented [JDF16]: The information in this table should not be randomly arranged, as was done here.

Sort this table's contents by reference designation:
Unit 1: 1BT1, 1BT2, 1U1
Unit 2: 2A1, 2A2, 2U1, 2U2, ...

Commented [JDF17]: Define this acronym in the written prose, or as a note that is placed with and immediately below the table, as I've demonstrated here.

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¹ Commercial off-the-shelf

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Table 2. Group Member Assignments: Software Assemblies

Software Designation	Software Element	COTS?	Assigned To
IUI1MAA1	Mobile App Architecture	N	Matt Soehngen
IUI1FLS1	Feedback Loop Sensor	N	Matt Soehngen
IUI1GPO1	GPIO Output	N	Nicholas Erickson
IUI1UPS1	User Preferences and Settings	N	Sterling LaBarbera
IUI1BCM1	Bluetooth Connection Manager	N	Nicholas Erickson

Commented [JDF18]: Caption text. Write captions as ordinary sentences. Do not use Title Case Capitalization when writing caption text.

Commented [JDF19]: Software is not a physical assembly constructed of basic component parts like resistors, wire, solder, nuts, bolts, etc.

Commented [JDF20]: Sort the information in this table by the reference designations shown under the "Software Designation" column. Sort the reference designations using lexicographic ordering:

- IUI1BCM1
- IUI1FLS1
- IUI1GPO1
- IUI1MAA1
- IUI1UPS1

References

F

Commented [JDF21]: References grade: F

Remove all unnecessary / unused sections from the final draft of a report. If your report does not cite information obtained from outside sources, then it should not have a "References" section.

Do you own textbooks that define section headings with nothing at all written underneath the heading? You don't, right? So it should be self-evident that the final draft of a report should not have empty sections like this.