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Team 60: Solar Lighting Syste
Bi-Weekly Update 3

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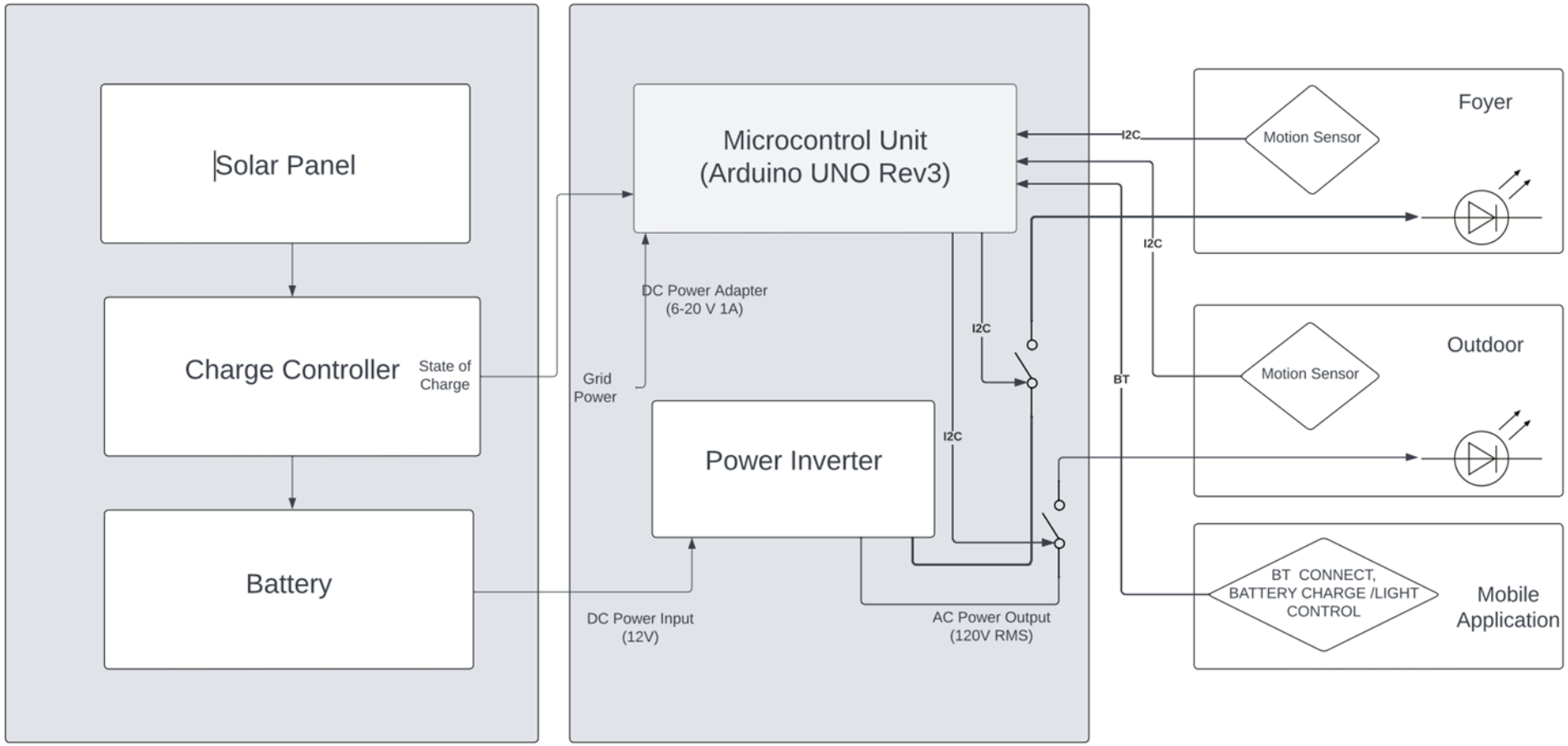
Sponsor: Dr. Wonhyeok Jang
TA: Rhett Guthrie

Project Summary

- A need for clean, renewable sources becomes more apparent than ever.
- Our home indoor and outdoor lighting system is the first step towards this, using **solar power.**
- Design an indoor/outdoor home lighting system that operates with a battery, power conversion, mobile application functionality, BT microcontroller for switch automation from motion sensors.

Project/Subsystem Overview



Project Timeline

Subsystem Designs (completed 01/16)	Subsystems ordered and soldered (2/14)	Integration of Bluetooth and Arduino (to complete by 2/21)	Integration of Solar Charge Controller and MCU (3/9)	Final Integration (to complete by 3/15)	System Test (to complete by 3/21)	Validation (to complete by 3/25)	Demo and Report (to complete by 4/1)

Solar Charge Controller

Accomplishments since last update 10 hrs of effort	Ongoing progress/problems and plans until the next presentation
- PCB board soldered - Gotten voltage output from one of the solar panels, confirmed working - Preliminary datapoints for battery percentage attained. Likely wrong though.	- Print 3D model for enclosure over Blitz - Finish verifying necessary final values for Charge Controller - Sun is temperamental and necessary for good testing.

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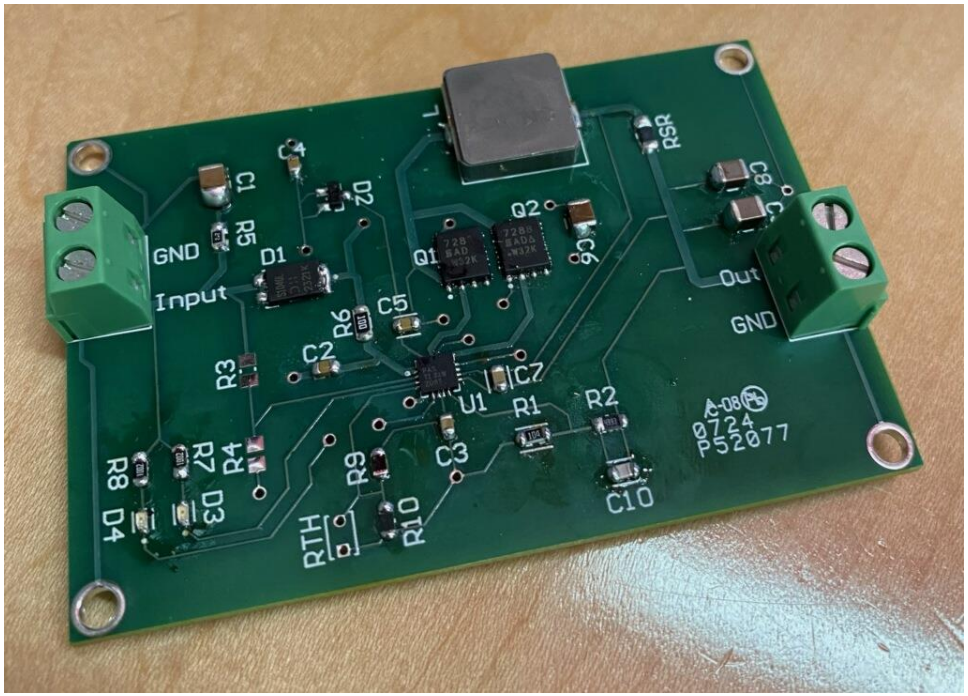
Solar Charge Controller

Lyric Haylow

Solar Panel to battery testing using provided Charge Controller, introduces sun issues

Time (AM)	Change in time (minutes)	Battery Voltage (Voltage
9:42	0	14.2
10:23	41	14
10:33	51	14.3
10:43	61	14.01



Inverter Subsystem

Jeb Malek

Accomplishments since 403 25 hrs of effort	Ongoing progress/problems and plans until the next presentation
Power transformer voltage invalidated In-circuit serial programming issue	PCB Correction Ordering Corrected Version Assembly & Validation 12V – 5V Converter PCB Order

- Evaluated Configuration Bits for Programming dsPIC

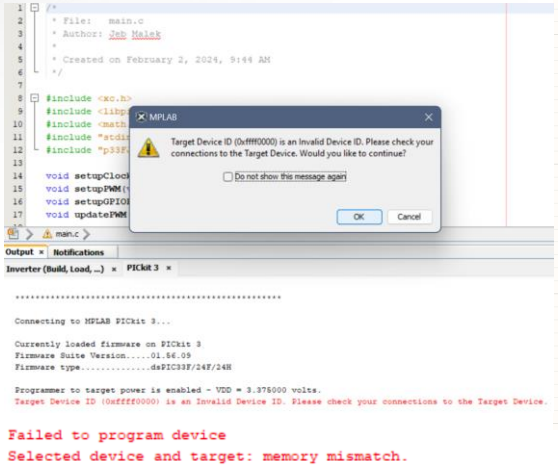
  Speaking with sponsor about alternative changes to scope.

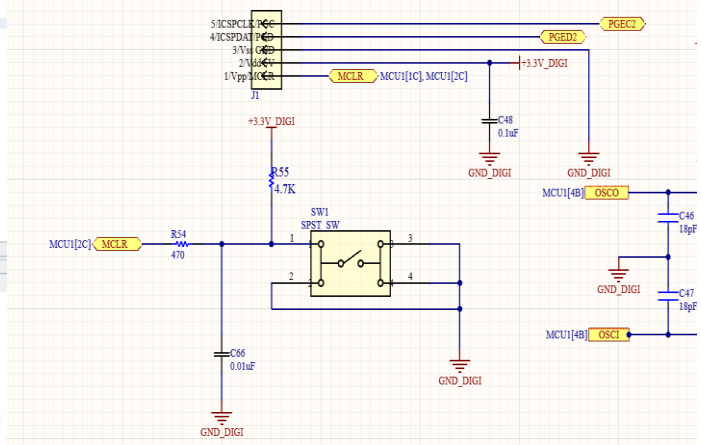
Inverter Subsytem

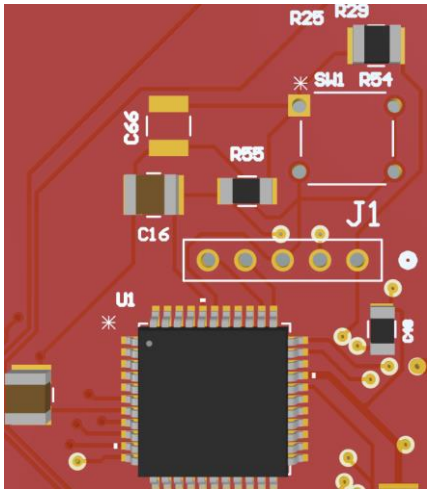
Jeb Malek

Verification DSPIC33FJ16504

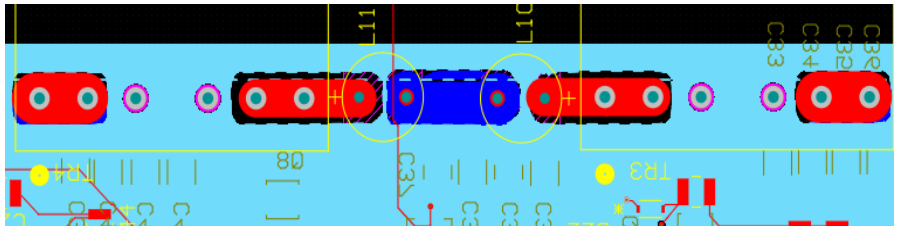
Target Device ID Connection Issue

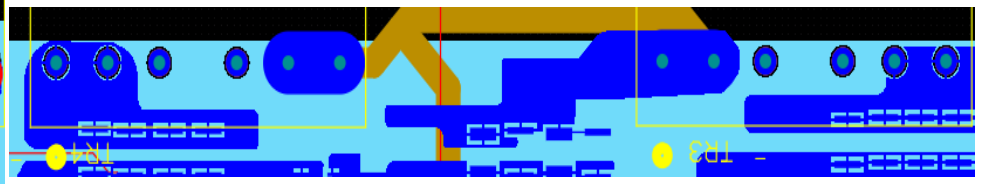






PCB Error Edit Ground Polygon Cutout / Via Solid Connections

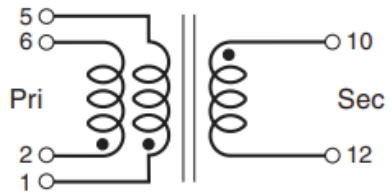




Inverter Subsytem

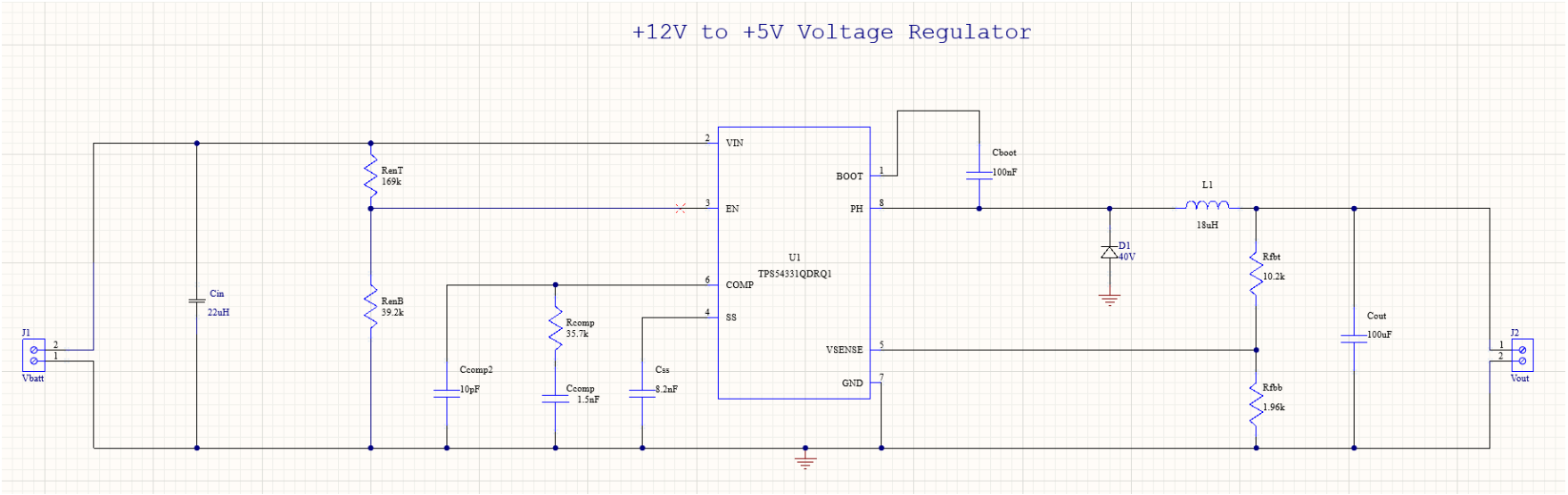
Jeb Malek

Transformer Schematic



Primary windings to be connected in parallel on the PC board.

Converter Schematic



Microcontroller Subsystem

Jeb Malek & Josh George

Accomplishments since 403 — 20 hrs of effort	Ongoing progress/problems and plans until the next presentation
Passive Infared (PIR) Sensors Tested Coded microcontroller sensor relay information	Testing of Sensor proximity & distance Testing of Controlled Relay Communication with Arduino Testing of Relay with Light Load

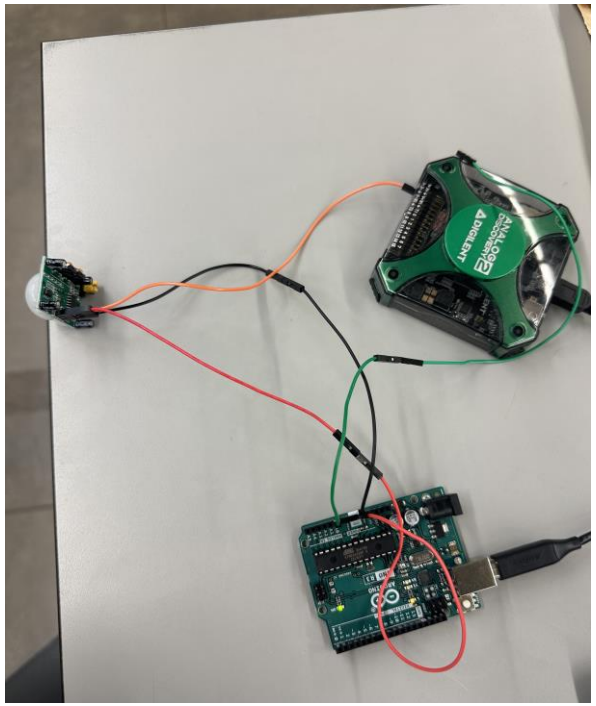
- Evaluated Sensor High & Low Communication Signal
- Future Test Bluetooth App with relay control, receive of motion sense, sign of demonstration structuring

Microcontroller Subsytem

Jeb Malek & Josh George

DC	4.988 V
True RMS	4.988 Ṽ
AC RMS	2 mṼ

-42 mV
42 mṼ
2 mṼ



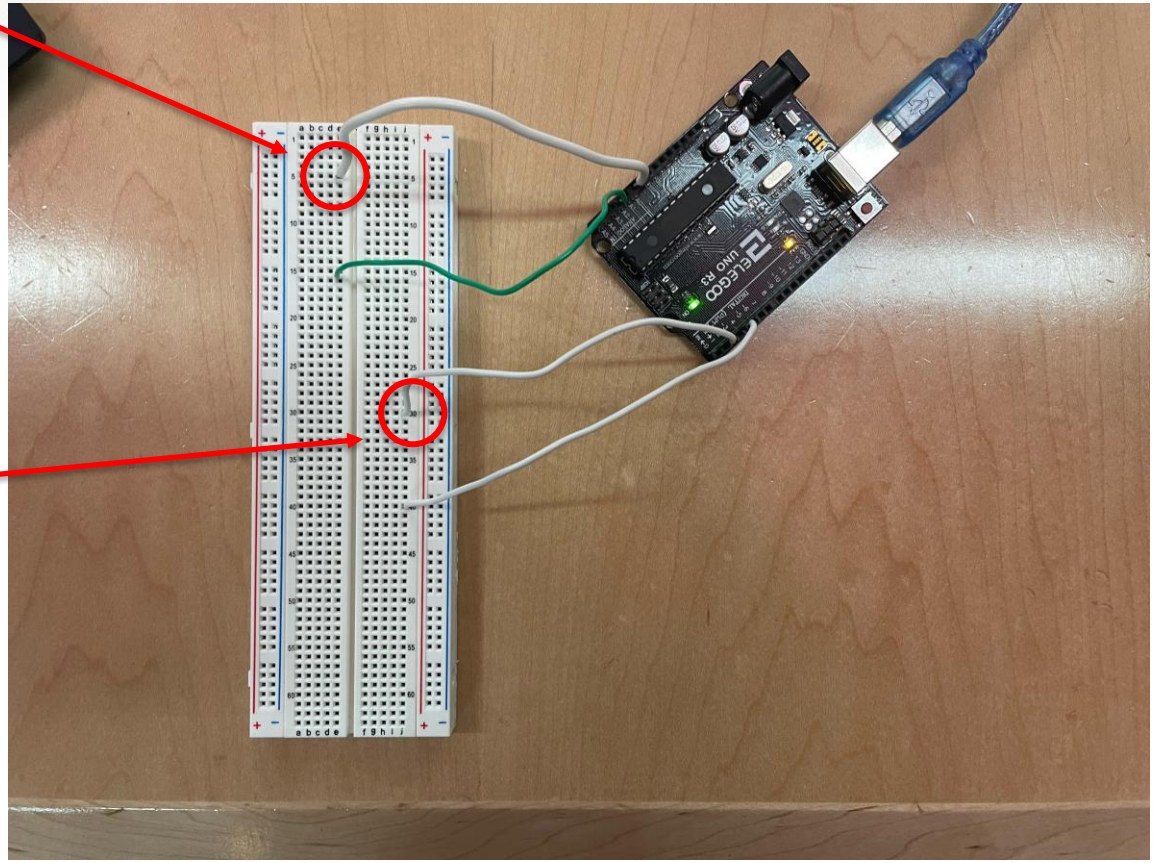
PIR Motion Sensor Test

Microcontroller Subsytem

Jeb Malek & Josh George

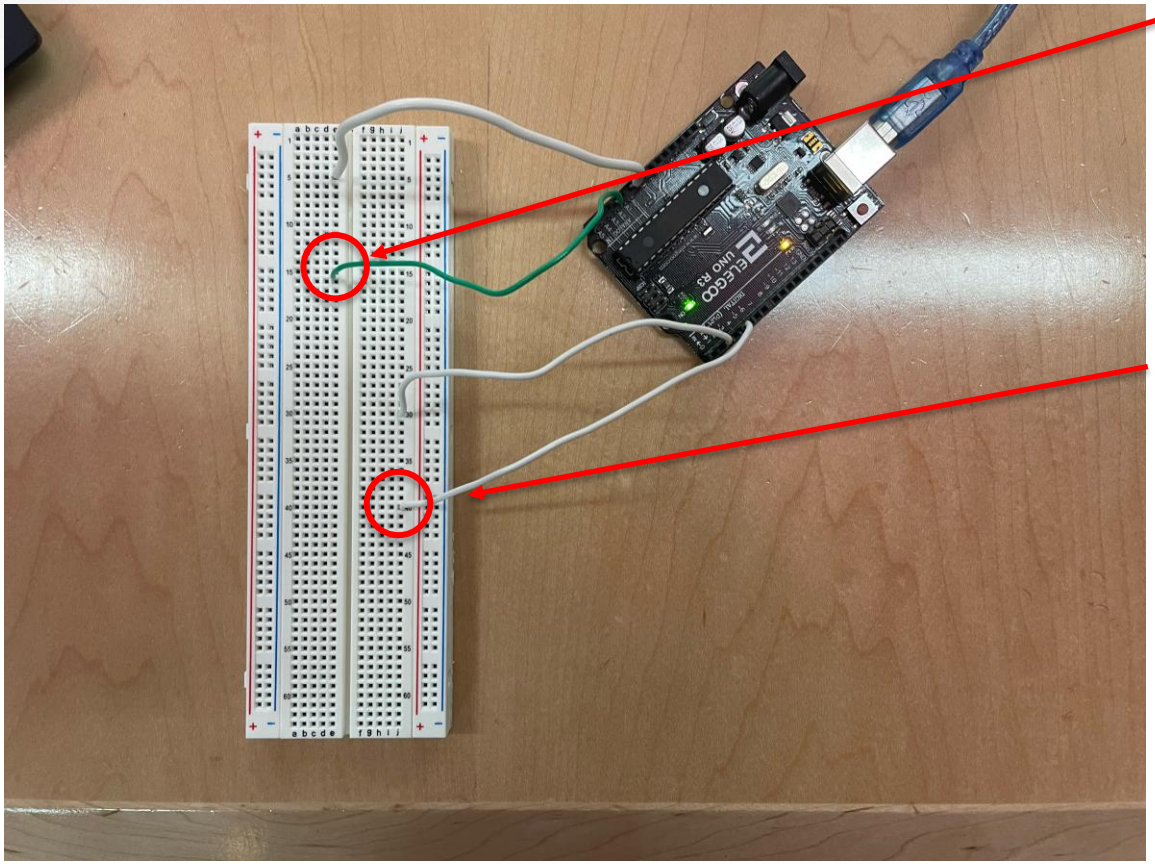
Sensor 1 Reading Pin

Sensor 1 Lights



Microcontroller Subsytem

Jeb Malek & Josh George



Microcontroller Subsytem

Jeb Malek & Josh George

- Main error found during testing: Sensor 1 activates Sensor 2 lights too, and Sensor 2 activates sensor lights as well.

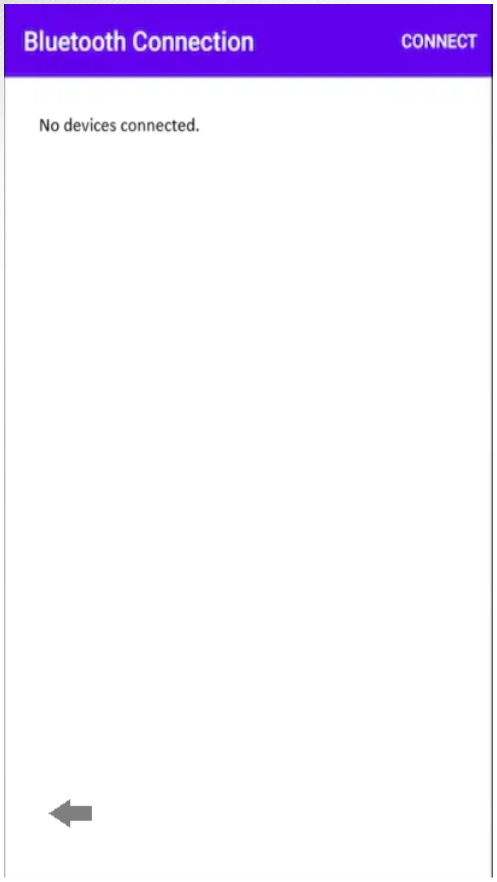
Mobile Application

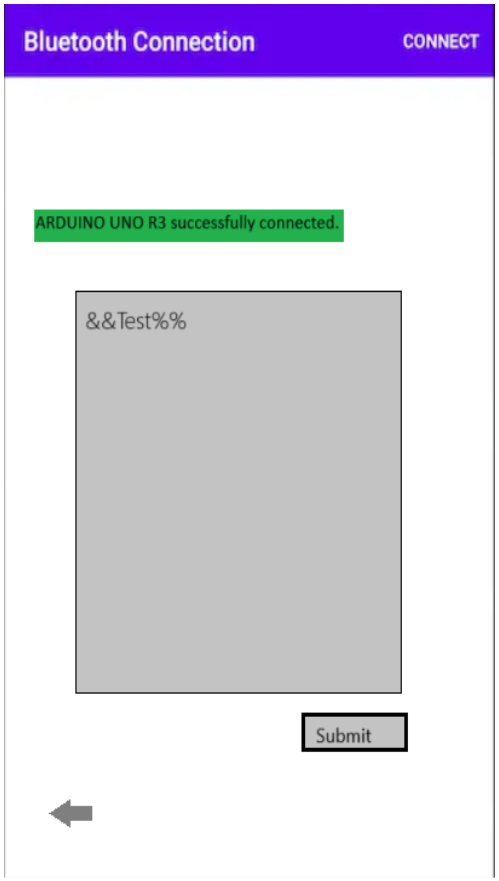
Josh George

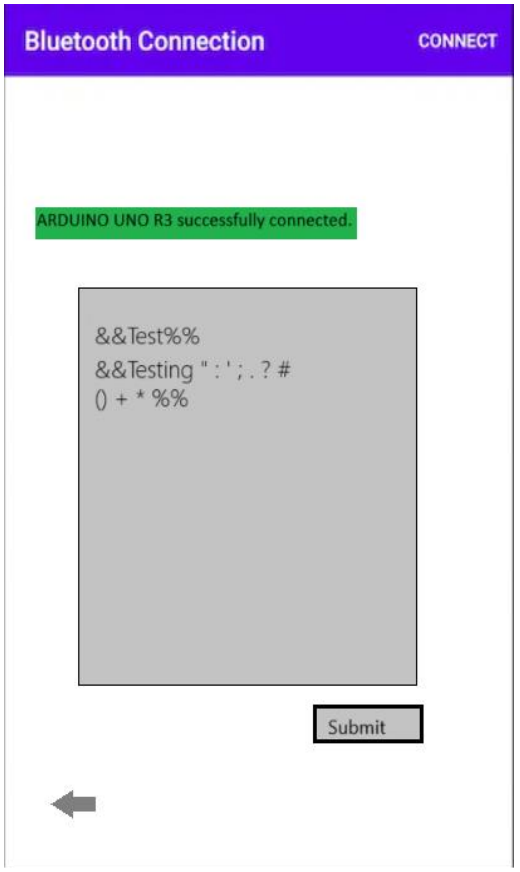
Accomplishments since last update 2 hrs of effort	Ongoing progress/problems and plans until the next presentation
-Added Bluetooth special characters functionality.	-Finish coding microcontroller sensor relay. -Add input pin option for solar charge controller.

Mobile Application

Josh George







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Execution Plan

TASK	21-Jan-24	28-Jan-24	4-Feb-24	11-Feb-24	18-Feb-24	25-Feb-24	3-Mar-24	10-Mar-24	17-Mar-24	24-Mar-24	31-Mar-24
Application											
Bluetooth Widget											
Bluetooth Screen											
Working Connection to Arduino											
Data input to MCU											
Data output to MCU											
Battery Preferences											
Complete Interface											
Solar Charge Controller (SCM)											
Solar Panel Testing											
Order Parts											
MK2 PCB Designing & Ordering											
Soldering Solar-PCB-Battery											
Design 3D print enclosure											
Solar-to-MPPT Testing and Verification											
Implement System											
Test Battery Charging over time											
Integrate with System											
Power Inverter											
Load Measurements, Operating Conditions											
Topology Selection for DC/AC Inverter											
Pulse Width Modulation Switching Part Select											
PWM Pure Sine Wave Schematic Verification											
Inverter PCB Design											
Inverter PCB Soldering											
MCU Programming											
Battery Input Verification											
Transformer Voltage Verification											
Power Regulation Verification/System Integration											
Switching Verification											
Full Load Support Testing											
Full Load Solar Light System Demo											
Microcontroller											
Select Microcontroller											
Select Components for Power Circuits											
Select Motion Sensors and Light Sensor											
Design Power Converters											
Design Battery Monitor											
Order Parts											
Develop Code for Microcontroller											
Solder PCBs											
Verify Sensors											
Verify Power Switches											
Simulate and Confirm Power Circuits											
Schematic Design											
PCB Designs											
Order PCB											
Verify Battery Connection											
Final Testing and Verification											

Validation Plan

App Requirements				
3.2.5.1	App Connection to phone Via USB	Android studio establishes a connection with Android phone when connected via micro USB	Beginner code in android studio	
3.2.5.2	App Connection to phone Via APK F	Android studio establishes a connection with the Android phone when the app is downloaded on the phon	Beginner code in android studio, uploaded through Bluetooth	
3.2.5.3	Establish Bluetooth Connection witl	Able to connect to a bluetooth capable device and detect the serial number	Work with microcontroller Bluetooth package to connect to android studio	
3.2.5.4	Bluetooth Communication via App	App displays screen with good connection.	Make sure code runs successfully on Android device	
3.2.5.5	Main Screen	App is able to display a home screen	Code home screen in Android studio, make sure it runs, debug errors.	
3.2.5.6	Data from Charge Controllor	App is able to connect to charge controller and accurately display readings.	Understand how charge controller connects to MCU, adapt code accordingly.	
Solar Panel Battery Charge				
3.2.1.1	Solar Panel Mount	Stays in space mounted for several days time	Verifying Hardware is properly mounted	
3.2.1.2	MPPT Functionality	MPPT is working as expected within the IC	Set higher voltage than MPPT, check whether IC brings voltage down to set MPPT voltage level.	
3.2.1.3	Charge Controller Verification	Voltage levels are modulated along with Current Levels	Steadily increasing current will be applied to charge controller, to point of max expected	
3.2.1.4	Overvoltage Solar Panel Protection	Supply voltage levels do not exceed IC limits	Sending a increasingly higher voltage through the charge controller, eventually checking it functions as predicted	
3.2.1.5	Overcurrent Battery Protection	Charging current levels do not exceed expected input values	When charging battery, consistently measuring charging current upon increasing supply voltage using DC power supply	
3.2.1.6	PWM EMI Interference	Interference does not significantly alter design guidelines	Use a Broadband RF meter if one available, if not then the Oscilloscope to identify interference points.	
3.2.1.7	Battery Charging to Capacity	Battery stops being charged once it has a full charge	Feeback voltage will be applied back to IC as shown in documentation	
3.2.1.8	State of Charge (SOC)	Measurement for current State of Charge coincides with expected values	Measure the voltage with a multimeter and convert measured voltage to approximate power percentage expected	
3.2.1.9	Depth of Discharge (DOD)	Measurement for current State of Charge coincides with expected values after discharge	Measure the voltage with a multimeter and convert measured voltage to approximate power percentage expected	
Power Inverter Characteristics				
3.2.2.3	PWM EMI Interference	Amplitude modulation ration falls in desired values for correct switching frequency EMI	In a unipolar switching topology the pulse width modulated signal should be a desired value to obtain suit	
3.2.2.5	Output Voltage	Inverter will supply a steady 120 VAC RMS value	With an attached load a benchmark of current drawing configurations to satisify stable pure sine wave voltage of 120 RMS	
3.2.2.6	Output Frequency	Inverter will supply a steady output sinusoid at a frequency of 60 Hz	Proper inverted sine waves shall operate at normal operating constraint of 60 Hz	
3.2.2.7	DC/DC Conversion	Inverter will supply 3.3 V / 1 A USB-C regulated output	Attaching E-Load to Inverter USB-C Receptacle provides 3.3 V load at varying currents	
3.2.2.8	Output Stability	Output Voltage Ripple demonstrates acceptable output harmonic components below certain THD	Measurement with Oscilloscope and E-Load with charging and discharging states can cause voltage flucuation	
3.2.2.9	Varying Loads	Inverter will supply light loads of varying configurations	Measurement with Oscilloscope and E-Load with benchmark loads attached while charging, discharging, in all modes of operati	
Microcontroller and Sensor Characteristics				
3.2.3.1	Sensor Detection Rate	The indoor sensor miss rate does not exceed 5% and outdoor sensor miss rate does not exceed 10%	Move an object within detection ranges over a 30 min duration. Monitor for detected objects using its output.	
3.2.3.2	Response Time	The time from sensor detection to a I/O signal heading to the relay must be less than 2 seconds	Measure time between output of sensor detection and output from microcontroller to relays.	
3.2.3.3	Bluetooth Connectivity	Microcontroller is able to connect to a mobile device via Bluetooth	Use multiple devices and connect to the microcontroller via bluetooth.	
3.2.3.4	Peripheral Input Voltages	The input voltages of the microcontroller and peripherals shall be 3V-3.6V	Use a multimeter to validate.	
3.2.3.5	Application Communication			
3.2.3.6	System Integration	Arduino receives communication from motion sensors, Verified mobile application instruction	Check Logs of Arduino Bluetooth Communcations with Debugging circuit / application logs for sensor data continuity	
3.2.3.7	Response Time			
3.2.3.8	Response Time			