Dwight Look College of ENGINEERING
TEXAS A&M UNIVERSITY

Team 4: Automatic Solar Lighting System Bi-Weekly Update 3

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Sponsor: Wohnyeok Jang
TA: Fahrettin Ay

What is the Automatic Solar Lighting System?

Problem:

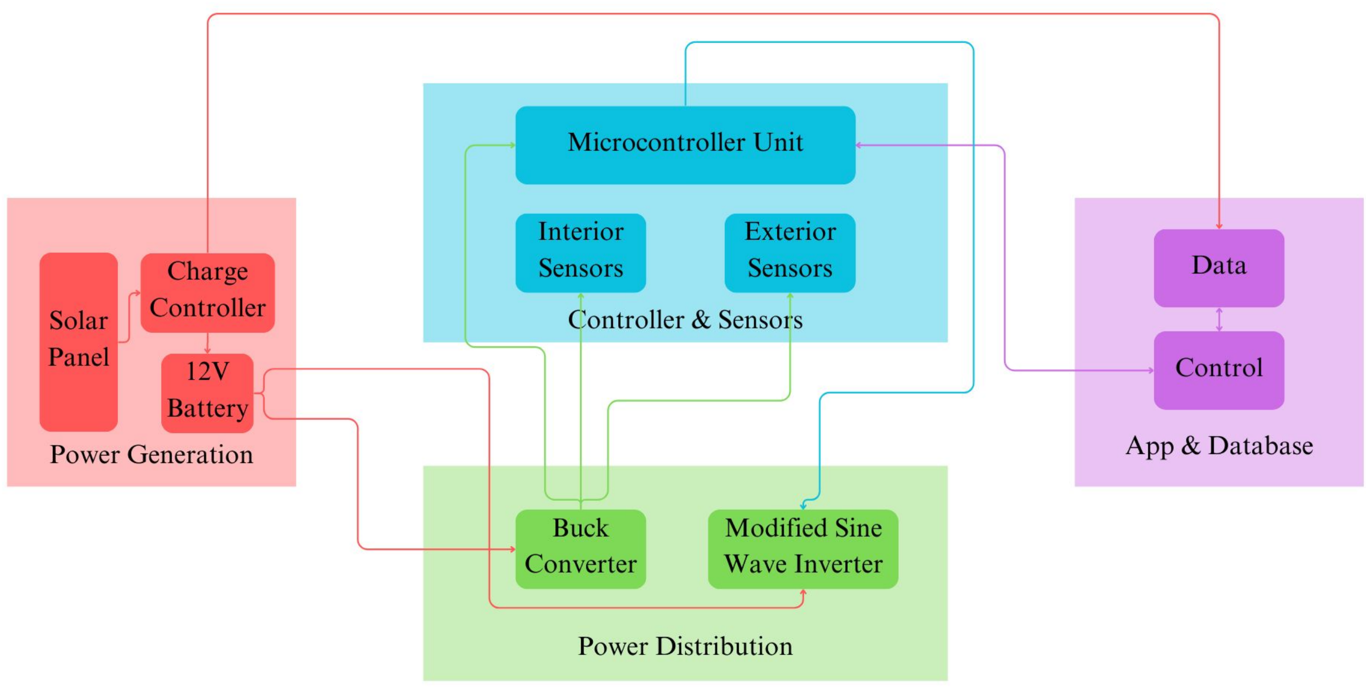
- Increasing grid demand and reliability issues make power outages more frequent.
- Integrating solar energy into homes ensures a dependable and independent power source.
- Solar power provides backup energy during outages, reduces electricity costs, and supports sustainability.

Solution:

- Solar panels provide up to a week of reliable power during emergencies.
- Motion-activated lighting for the foyer and patio ensures security and efficiency.
- Remote control via an app allows convenient access and management of the system.
- Enhances energy independence, cost savings, and sustainability for homeowners.

System Visual

Project/Subsystem Overview



Nick: Power Distribution

Romi: Controller & Sensors

Atahan: Power Generation

Cedar: App & Database

Project Timeline

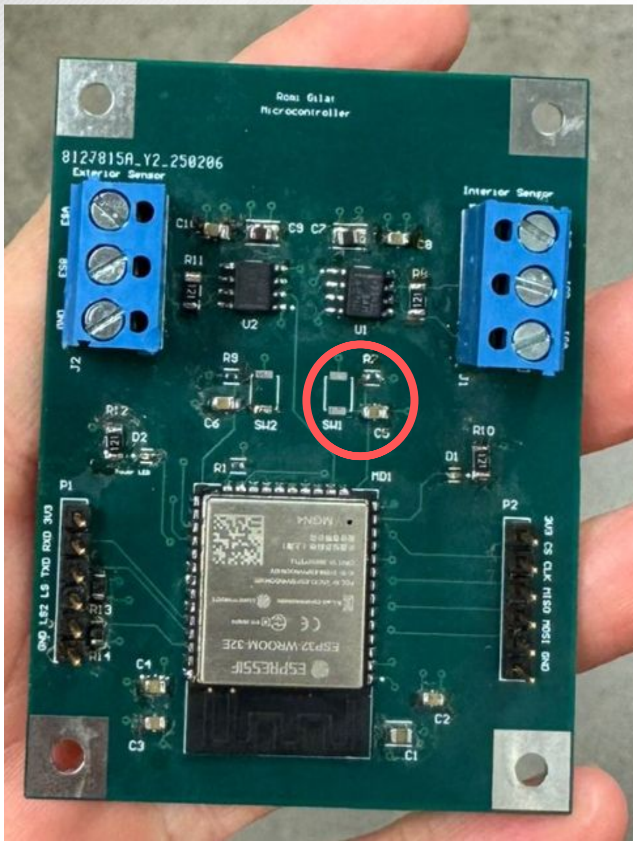
Subsystems designed and completed testing (Complete)	Integration of MCU and Power generation (to complete by 3/7)	Integration of MCU and Android App (to complete 3/7)	Integration of MCU and power distribution (to complete by 3/7)	System Test (to complete by 3/21)	Validation (to complete by 3/21)	Demo and Report (to complete by 4/28)

Controller & Sensors

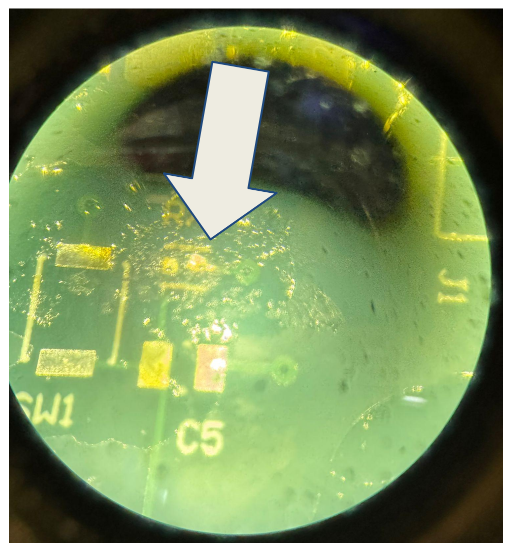
Romi Gilat

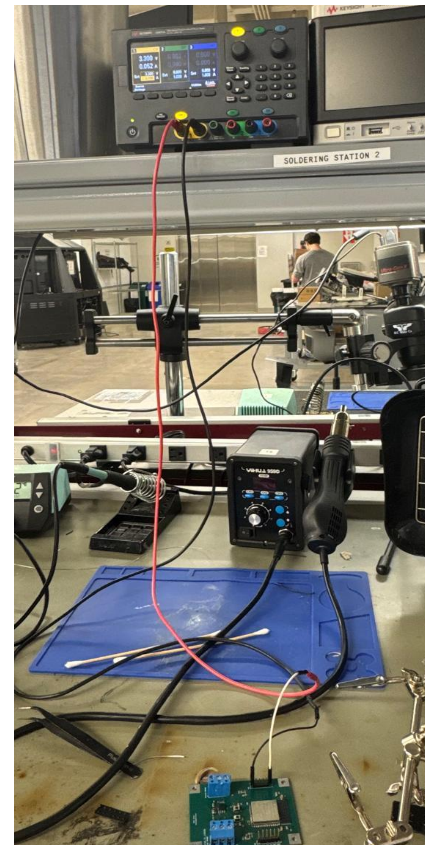
Accomplishments since last update 28 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Finalized MCU, ready for system integration. • Developed and tested a dummy MCU for integration validation, given to distribution & generation. • Implemented and tested MCU firmware for App connectivity; UART communication, LED indications, and GPIO functionality. • Connect MCU and Wi-Fi hotspot with Cedar • Updated GitHub repository with MCU coding environment and PCB schematics.	• Complete Sensor PCB. • Upload sensor code. • Test & validate Sensor system. • Integrate with main system.

Controller

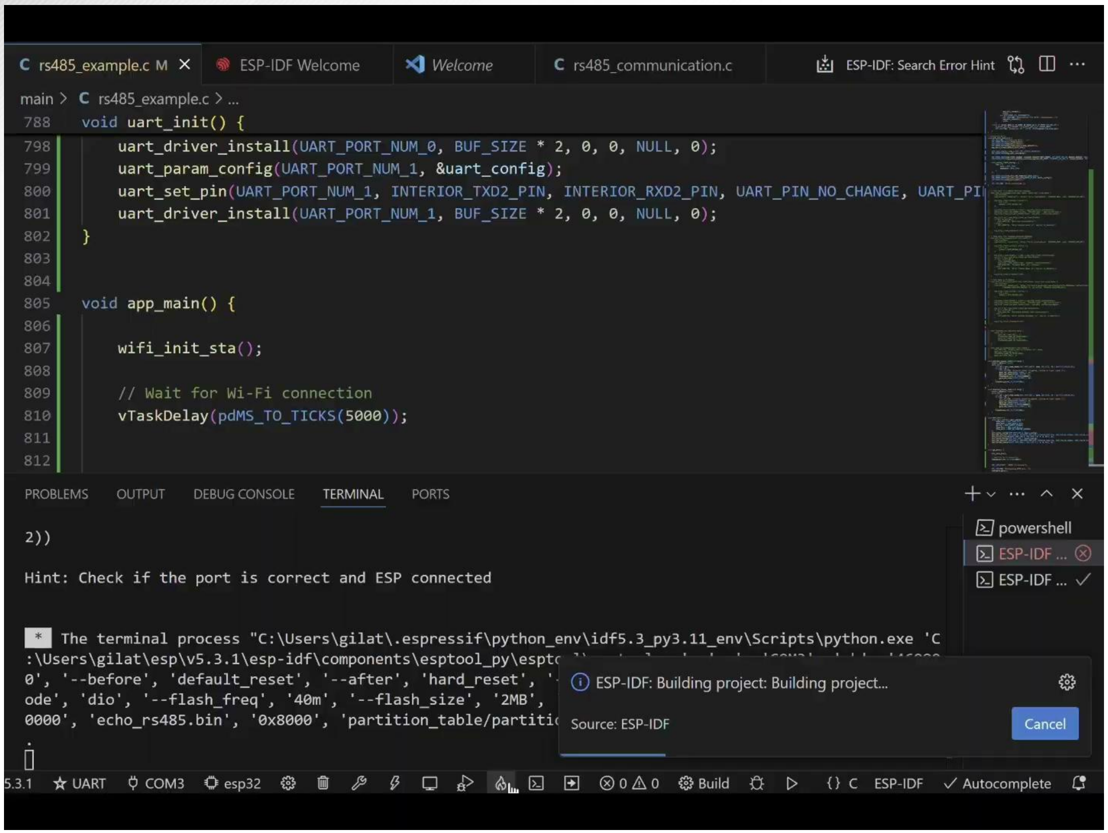

8127815A_Y2_250206
Exterior Sensor
Interior Sensor
U1
U2
SW1
SW2
C5
P1
P2
J1
J2
ESPRESSIF
ESP32-WROOM-32E


KEYSIGHT
E36311A
Triple Output Programmable DC Power Supply
1 CV
3.299 V
0.048 A
Set 3.300 V
0.500 A
2 OFF
0.002 V
0.000 A
Set 0.000 V
1.000 A
3 OFF
0.001 V
0.000 A
Set 0.000 V
1.000 A
Source Settings
Utilities
Lock Unlock
Voltage
Meter View
Tracking
Store/ Recall
Enter

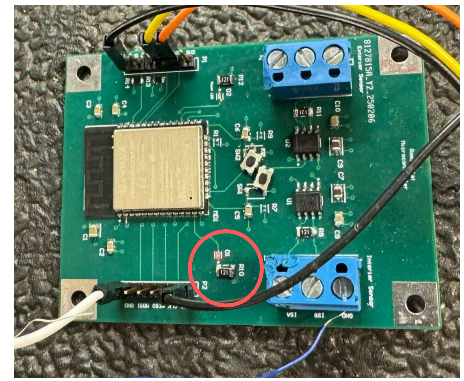

SW1
C5
J1


SOLDERING STATION 2

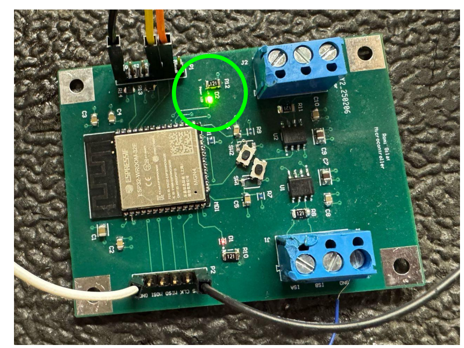
Controller



LEDs will indicate device power, code uploads, and data transmission. They will light up when information is sent from sensors, the app, and the MCU.



Device running:
Red LED



Code being uploaded:
Green LED

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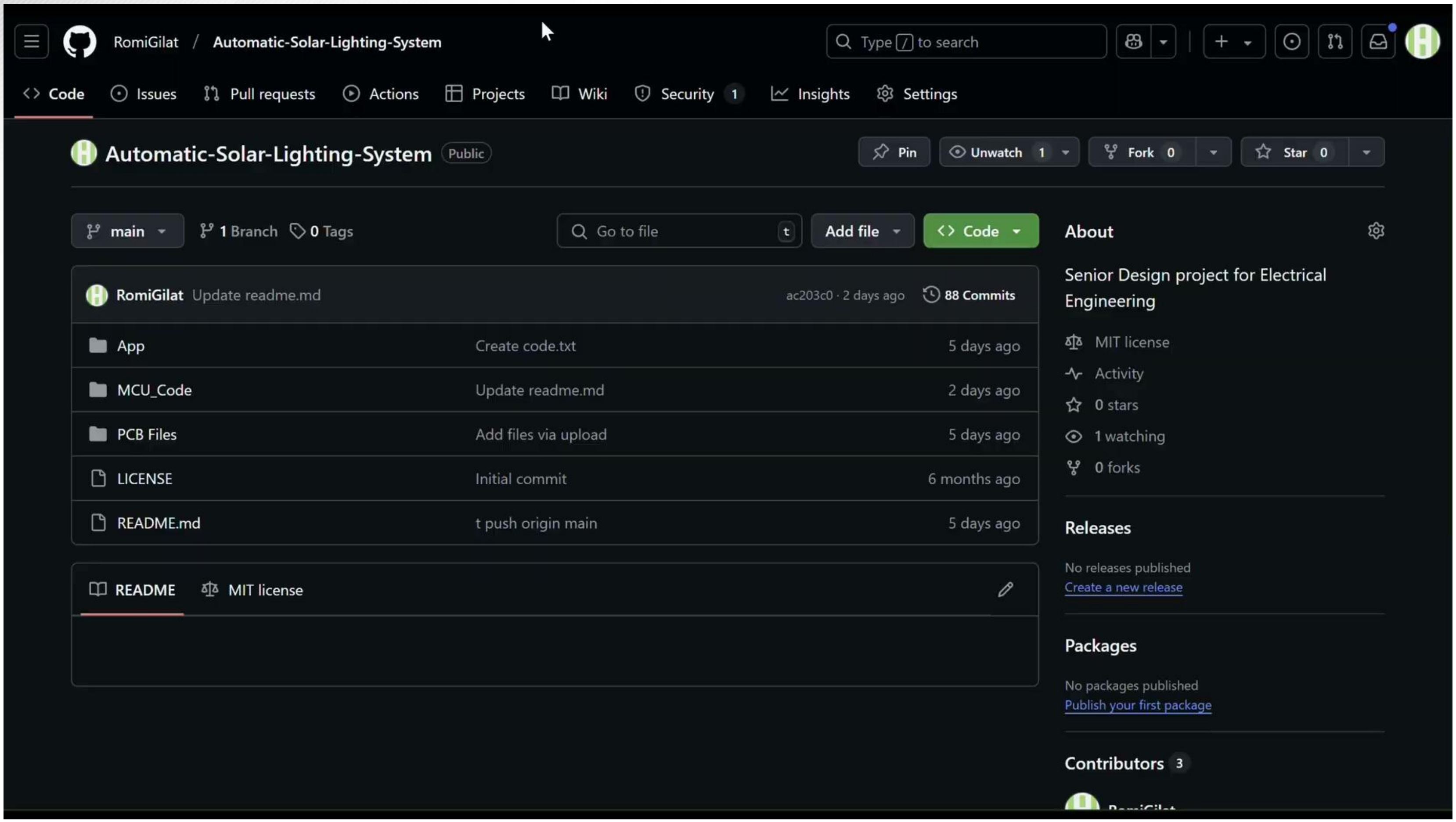
Github Updated



Power Generation

Atahan Bakanyildiz

Accomplishments since last update 20 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Charge controller completely tested • Power monitor PCB built and began testing • Power monitor off-the-shelf version ready for integration	• Power Monitor PCB finished testing • Power Monitor off-the-shelf integrated with esp-32 • Power Monitor PCB integrated

Power Generation

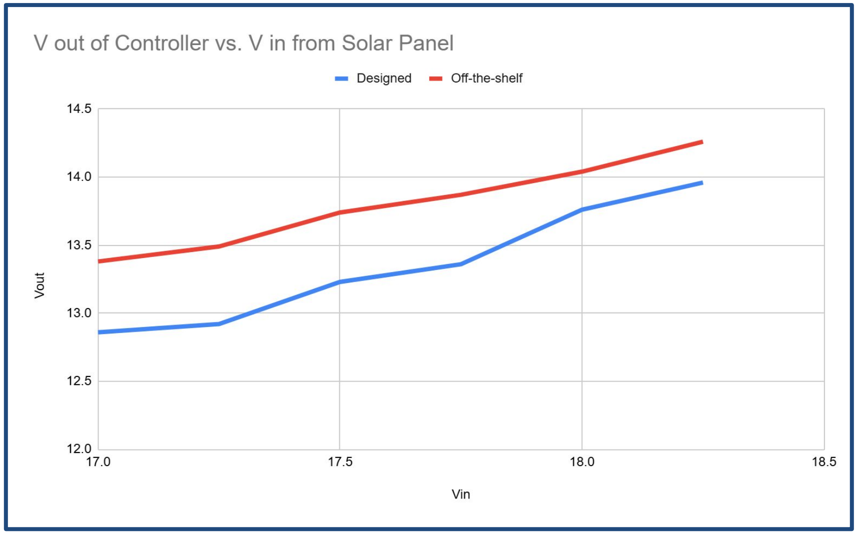
Charge Controller

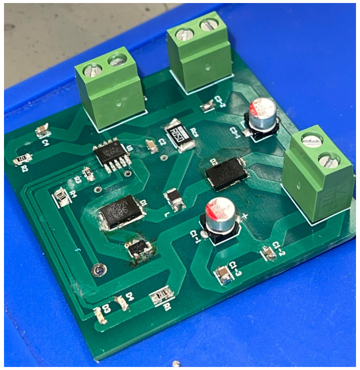
Charge Controller:

- Tested with power supply (emulate solar panel V).
- Same tests with off-the-shelf component.
- 3.56% discrepancy between the two.

Integration:

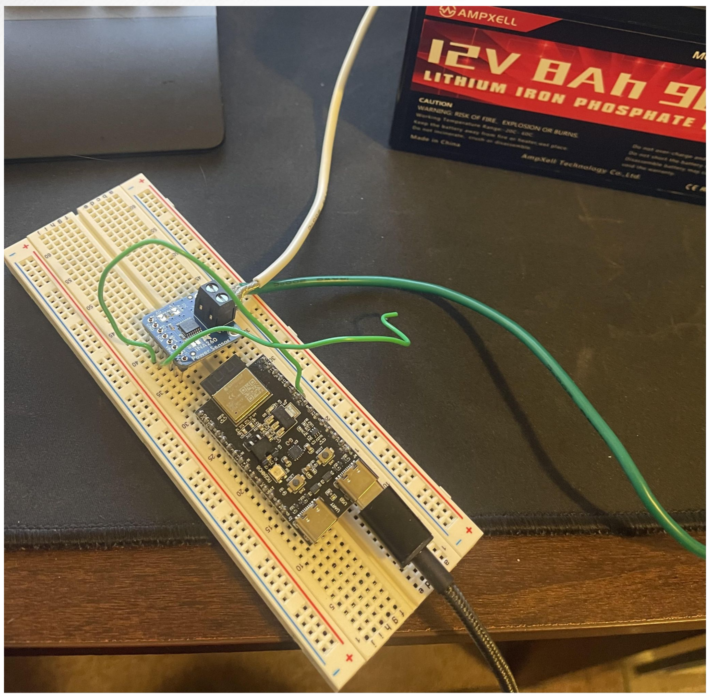
- Works fully with 12V battery.
- Battery integration ready with Power Distribution.
  - Fully operational with load on battery (tested with simple LED circuit)



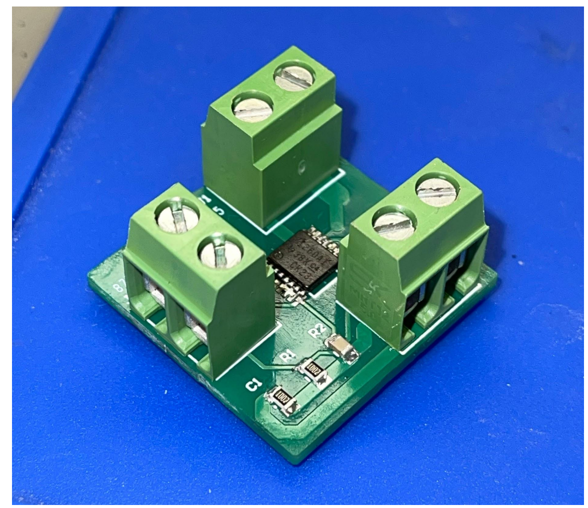


Power Generation

Power Monitor



Started testing with ESP-32 for power monitor.
Difficulties setting up ESP code.



PCB for power monitor finished being built.

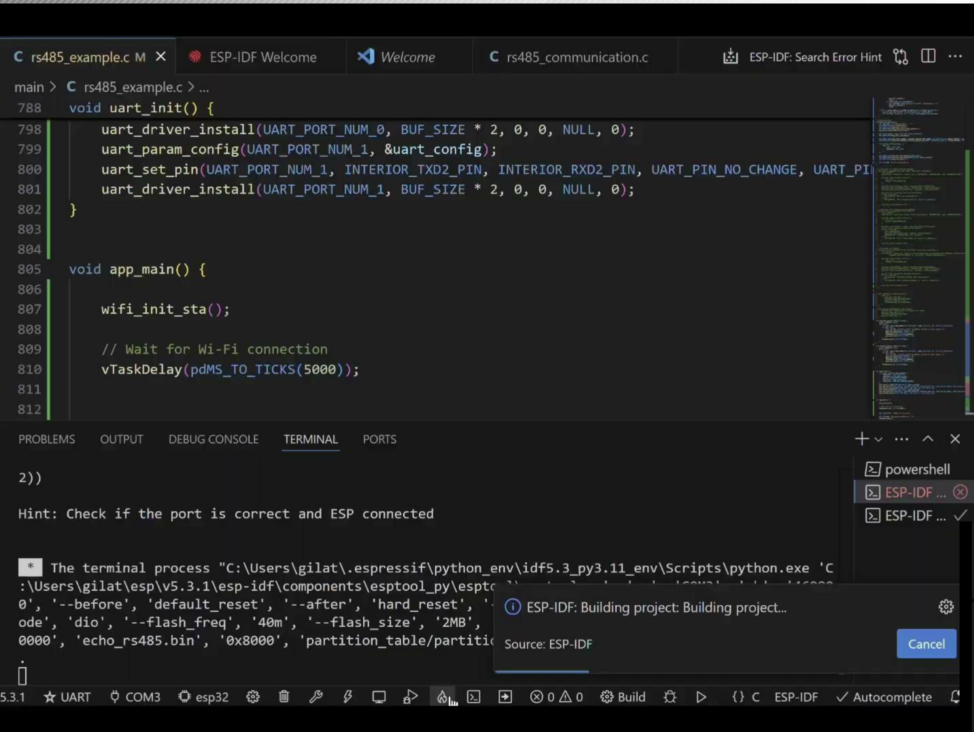
App & Database

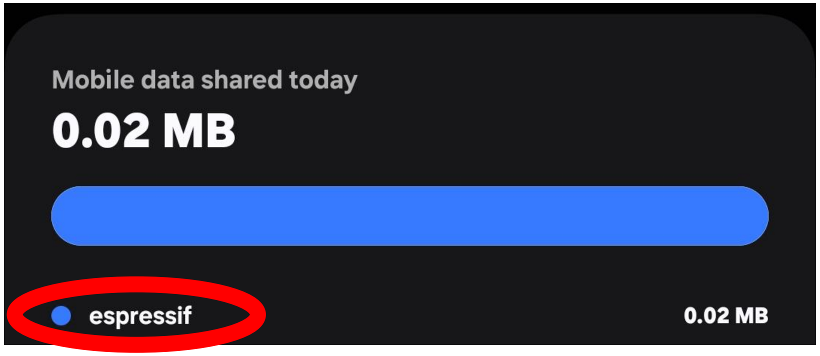
Cedar Maxwell

Accomplishments since last update 12 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Successfully connected ESP32 to Wi-Fi with combined Firebase/MCU subsystem code	• Firebase data transfer is functional independently, but does not function yet when integrated with Romi's code • ESP32 to synchronize data with Firebase – in progress. • Code to take future actual data from battery meter, etc.: in progress.

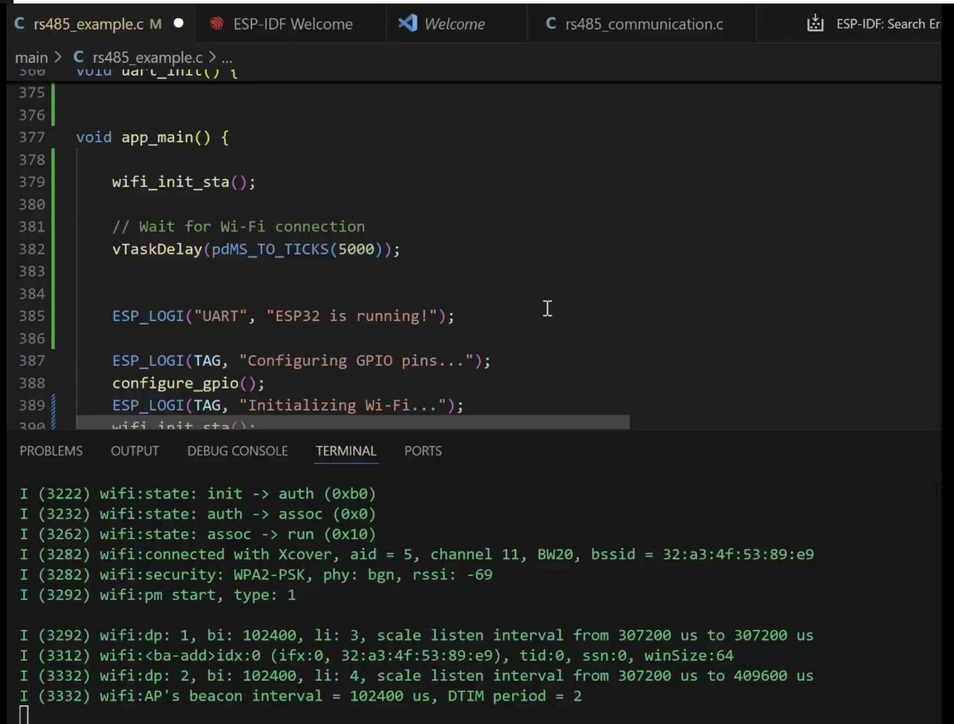
App & Database

Combined code built & flashed to ESP32.





Wi-Fi connected

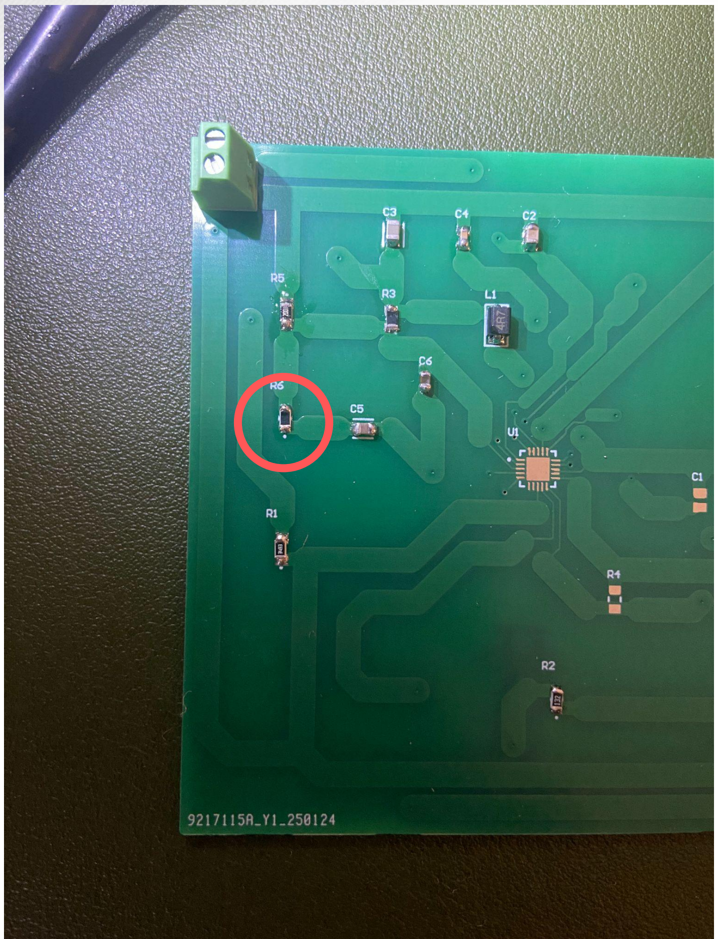


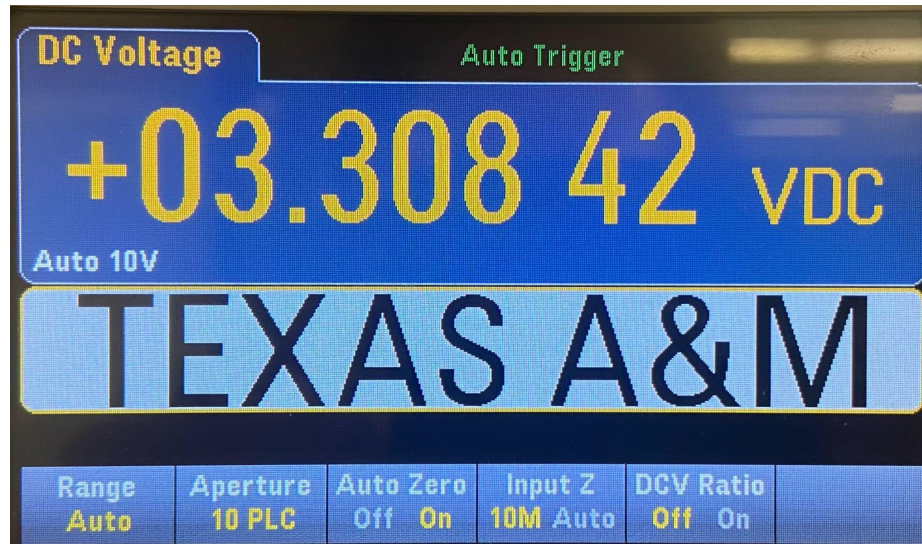
Power Distribution

Nick Miller

Accomplishments since last update 25 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Identified and corrected issue with Buck Converter. • Initiated implementation with Power Generation. • Tested Modified Sine Wave Inverter. • Identified and corrected issue with Modified Sine Wave Inverter.	• Integrate Buck Converter with Power Generation. • Integrate Modified Sine Wave Inverter with Controller & Sensors. • Test Battery duration/subject to different environments.

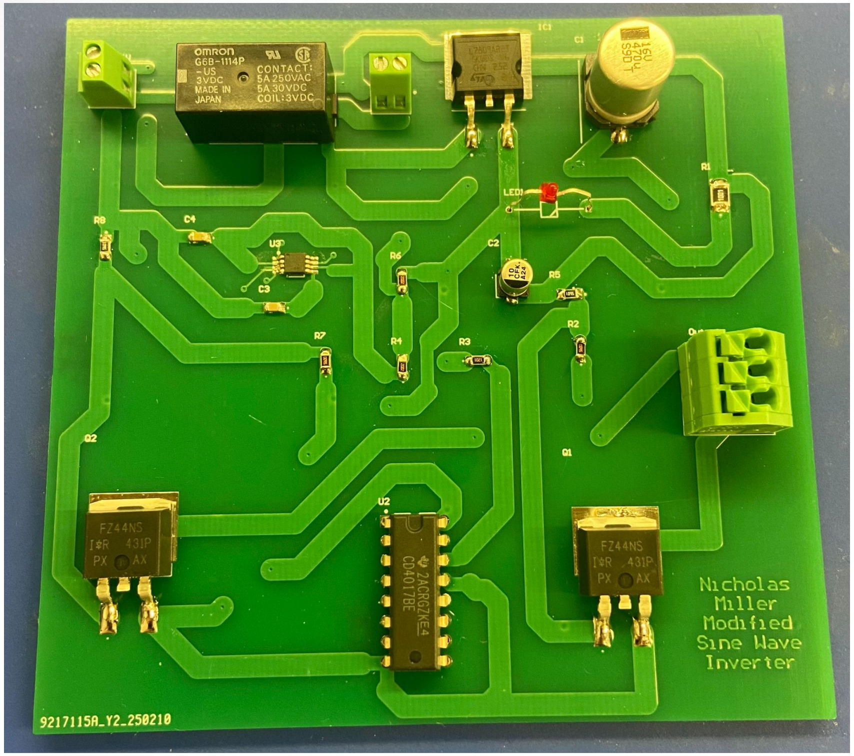
Power Distribution

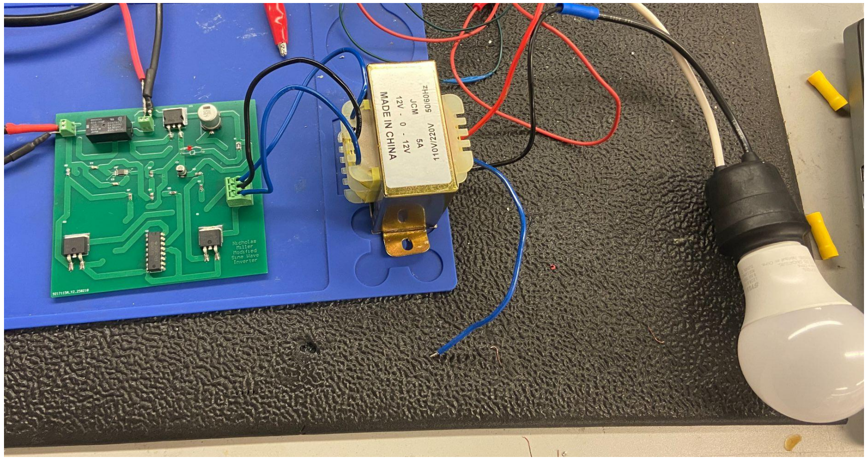




Correct Voltage output after replacing resistor R6.

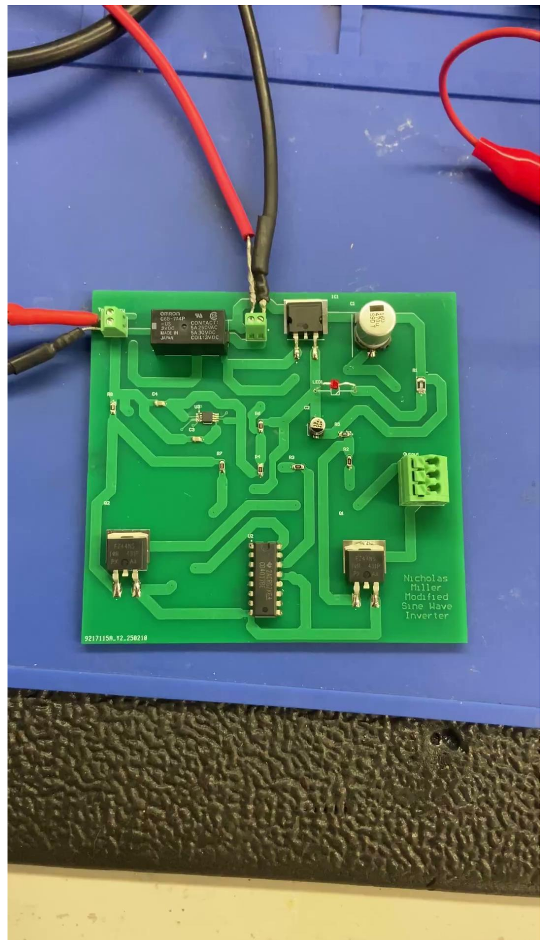
Power Distribution





Modified Sine Wave Inverter
Implementation setup.

Power Distribution



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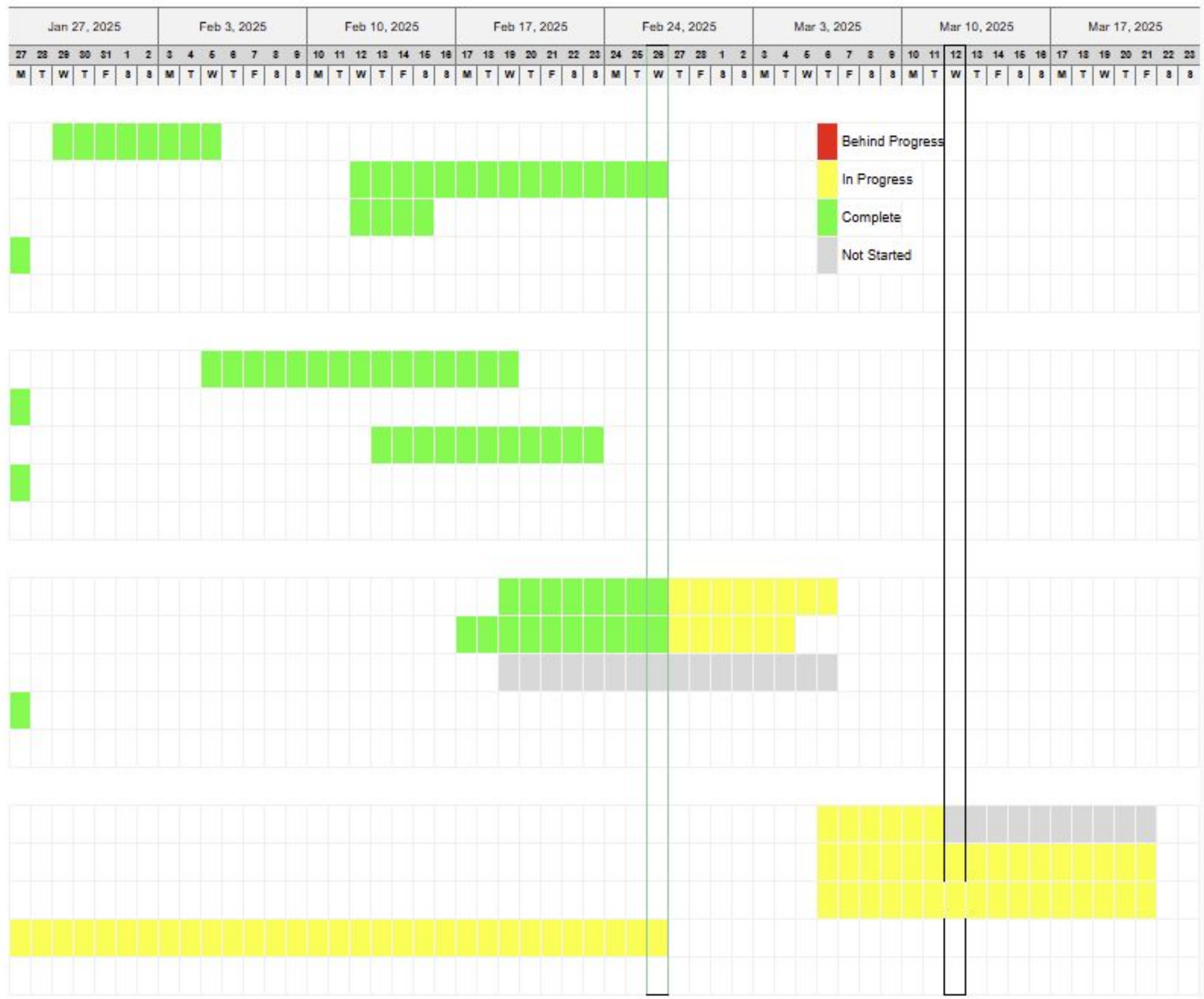
Execution & Validation Plan

TASK	ASSIGNED TO	PROGRESS	START	END
Testing Subsystems				
Tested Subsystem	Romi Gilat	100%	1/15/25	1/22/25
Test Subsystem	Nick Miller	100%	1/29/25	2/12/25
Tested Subsystem	Atahan Bakanyildiz	100%	1/15/25	1/19/25
Tested App and Database	Cedar Maxwell	100%	1/13/25	1/13/25
Completion Progress	Team	100%	1/15/25	1/25/25
Subsystem Redesign				
PCB Redesign	Romi Gilat	100%	1/23/25	2/5/25
Circuit and PCB Redesign	Nick Miller	100%	1/13/25	1/13/25
PCB Design and Test	Atahan Bakanyildiz	100%	1/13/25	1/16/25
N/A	Cedar Maxwell	100%	1/13/25	1/13/25
Completion Progress	Team	100%	1/13/25	1/16/25
Subsystem validation				
Build, Test & Validate	Romi Gilat	50%	2/5/25	3/6/25
Build, Test & Validate	Nick Miller	75%	2/17/25	3/4/25
Build PCB and Validate	Atahan Bakanyildiz	70%	2/22/25	2/27/25
App Completed and Synced with Firebase	Cedar Maxwell	100%	1/13/25	1/13/25
Completion Progress	Team	74%	2/22/25	2/26/25
Subsystem Integration				
Integrate subsystems	Romi Gilat	25%	3/6/25	3/20/25
Integrate with MCU/Sensors	Nick Miller	10%	2/20/25	3/7/25
Integrate with MCU	Atahan Bakanyildiz	15%	3/8/25	3/11/25
Firebase Connected with MCU	Cedar Maxwell	75%	1/13/25	3/7/25
Completion Progress	Team	7%	3/13/25	3/18/25



Validation Plan

Standby Wake-Up Miss Rate	The maximum number of miss trigger incidents within the sensor's field of view will be 15% or less.	UNTESTED	Romi Gilat
False Positive Rate	Within the sensor system, the false positive rate will be less than 15% in case of small animals or critters walking within the range.	UNTESTED	Romi Gilat
Battery Operating Time	The operating time of the 12V Lead-Acid battery shall be between 10 and 20 hours.	UNTESTED	Nick Miller
Solar Charging Time	The solar charging time shall be between 4 and 6 hours.	SUCCESS	Atahan
System Area	The system area shall include the rooftop, foyer and exterior of a household.	SUCCESS	Atahan
Installation	The solar panel installation will be done up to National Electrical Code (NEC), International Building Code (IBC), and International Fire Code (IFC), along with the mounting of the system 45 degrees tilted offset from the ground level for optimal sunlight units.	UNTESTED	All
Mounting	The automatic solar lighting system includes **solar panels**, an **indoor sensor with integrated lights**, and an **outdoor sensor with lights**. The lightweight design eliminates the need for structural support, and the solar panels are roof-mounted for optimal sunlight exposure	UNTESTED	All
Inputs	The Automatic Solar Lighting System processes multiple inputs across subsystems. The **Power Generation** subsystem captures solar energy via photovoltaic panels, while the **Buck Converter/Inverter** adjusts DC voltage for the MCU and lighting. The app monitors light status and subsystem performance in real time.	Partial Success	Atahan, Nick, Romi

Validation Plan continued

Power Consumption	The system shall consume approximately 18 Watts, 9 Watts per light bulbs.	UNTESTED	Nick Miller
Input Voltage Level	The input voltage level shall be +10 VDC to +14 VDC.	SUCCESS	Nick Miller
External Commands	The Automatic Solar Lighting System shall document all external commands in the appropriate ICD.	UNTESTED	Cedar Maxwell
Data Output	The Automatic Solar Lighting System will output the status of the porch and foyer lights by means of the mobile application.	UNTESTED	Cedar Maxwell
Diagnostic Output	The MCU will transmit diagnostic data to the app for display.	UNTESTED	Cedar Maxwell, Romi Gilat
Connectors	The Automatic Solar Lighting System will use the American National Standard for Electrical Connectors ANSI C119.6-2011.	SUCCESS	All
Wiring	The Automatic Solar Lighting System will follow the guidelines set forth by the National Electrical Code regarding electrical wiring. The standard applications of electrical systems is in the article NFPA 70 (NEC).	UNTESTED	All
Altitude	The Automatic Solar Lighting System shall be able to operate efficiently at altitudes around 300 feet.	UNTESTED	Nick, Romi, Atahan
Thermal	The Automatic Solar Lighting System shall be able to operate efficiently at temperatures ranging from 0℃ to 70℃. The microcontroller unit will be located indoors, where the temperature is expected to range from 0°C to 70°C. The sensor system will be used both indoors and outdoors, and is rated for temperatures from -40°C to 85°C.	UNTESTED	Nick, Romi, Atahan
Humidity	The sensor unit will function up to 90% humidity for proper functioning.The sensors themselves need to be placed in a water proof, sealed container that will prevent the electronics from getting drenched.	UNTESTED	Nick, Romi, Atahan

Thank you!