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ENGINEERING
TEXAS A&M UNIVERSITY

Team 04: Automatic Solar Lighting System Bi-Weekly Update 1

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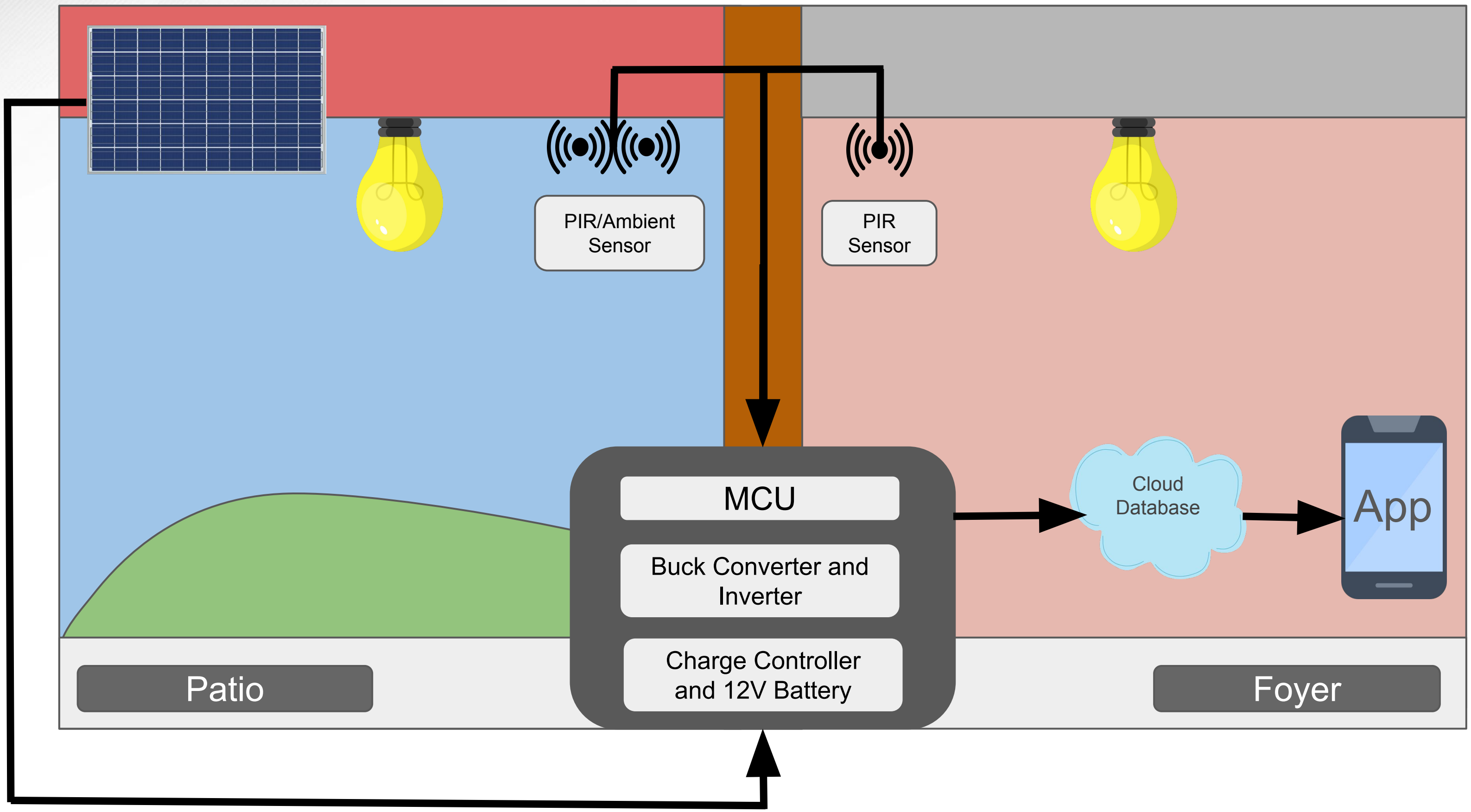
Sponsor: Wonhyeok Jang
TA: Fahrettin Ay

What is the Automatic Solar Lighting System?

- **Problem:** With increasing grid demand and reliability issues, integrating solar energy into homes is vital. Solar power offers a dependable, independent energy source, ensuring power during outages, reducing costs, and boosting sustainability.

- **Solution**: By integrating solar panels into homes, individuals can have peace of mind knowing they will have reliable power for up to a week during emergencies. This system will provide lighting, activated by motion, for the foyer and patio, and can be controlled remotely via an app for convenient access.

System Visual



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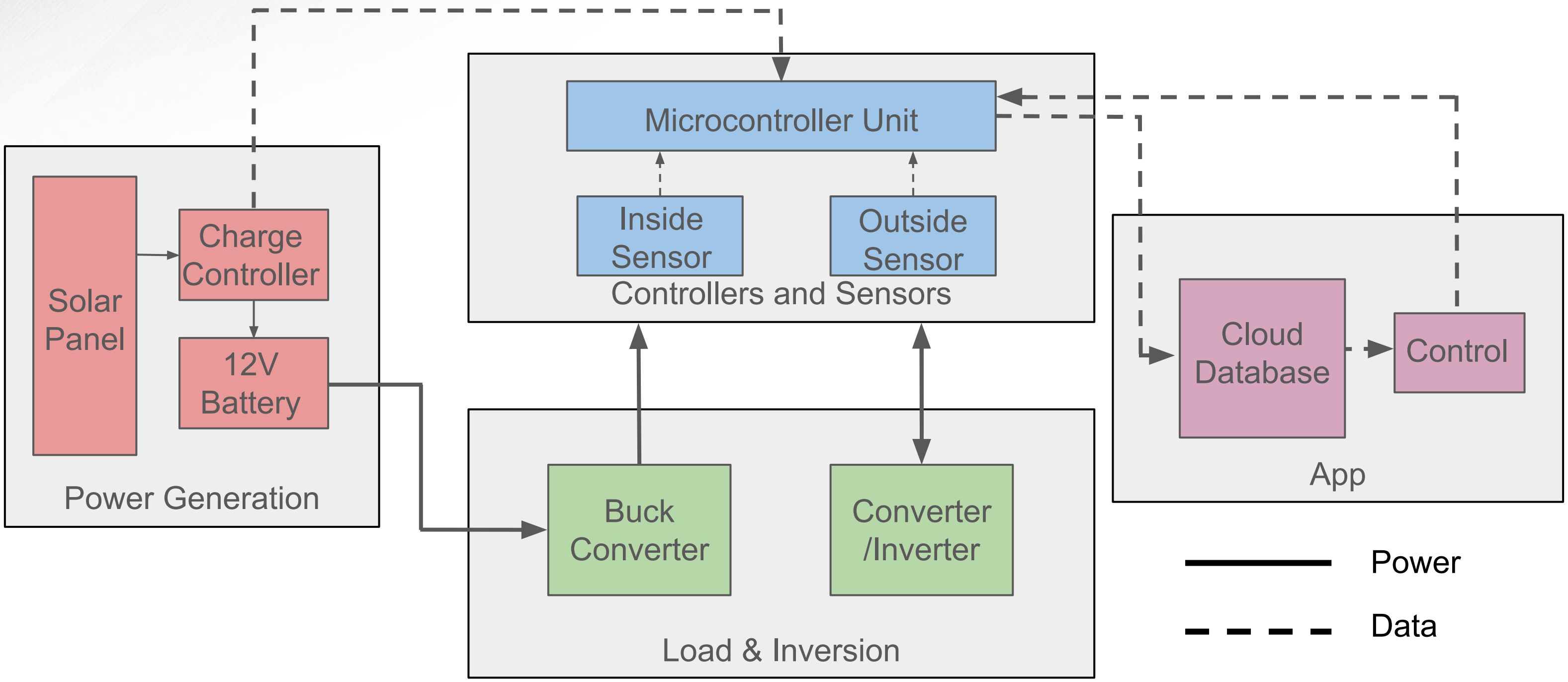
Project/Subsystem Overview



Nick: Load & Inversion
Romi: MCU & Sensor
Atahan: Power Generation
Cedar: App & Database

Major Project Changes for 404

- Redesign of MCU & Sensor Subsystem
- Redesign of Power Generation
- Redesign of Power Distribution

Project Timeline

	Execution Plan 1/13/2025 - 4/28/2025															
	1/15	1/22	1/29	2/5	2/12	2/19	2/26	3/5	3/12	3/19	4/2	4/9	4/16	4/23	4/30	Date
Testing of Components											Not Started					
Presentation 1											In Progress					1/29
Reordering of PCB											Completed					
Reordering of Components											Behind					
Completed PCB																2/10
Presentation 2																2/12
Power Generation and Distribtuion Integrated																
Subsystem verification complete																
Devices powered by Power Distribution Components																
MCU and App communication																
Presentation 3																2/26
MCU and Fuel gauge communication																
Presentation 4																3/19
Housing Complete																
Integration of Project Complete																
Presentation 5																4/2
Final Testing																
Final Design Presentation																4/16
Final Demo																4/23
Showcase Day!!																
Final Report																4/28

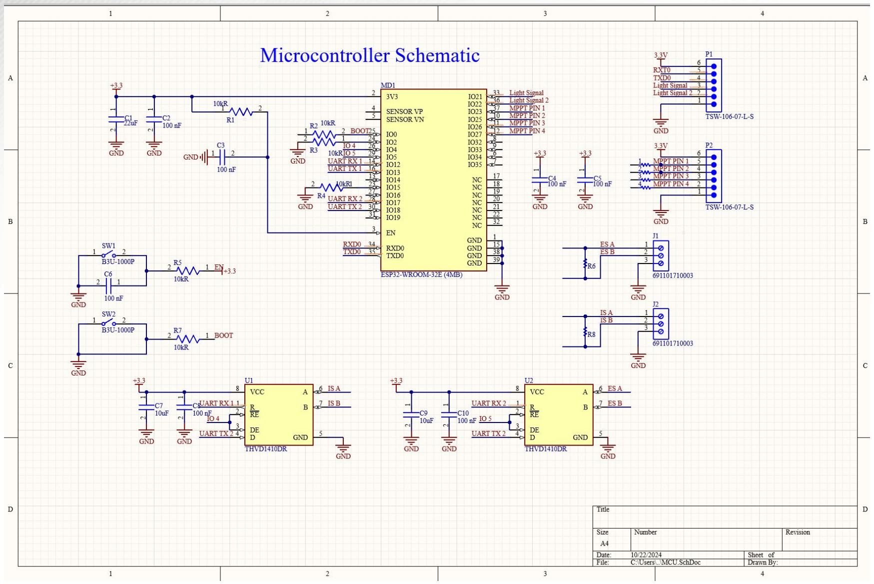
Microcontroller and Sensor Subsystem

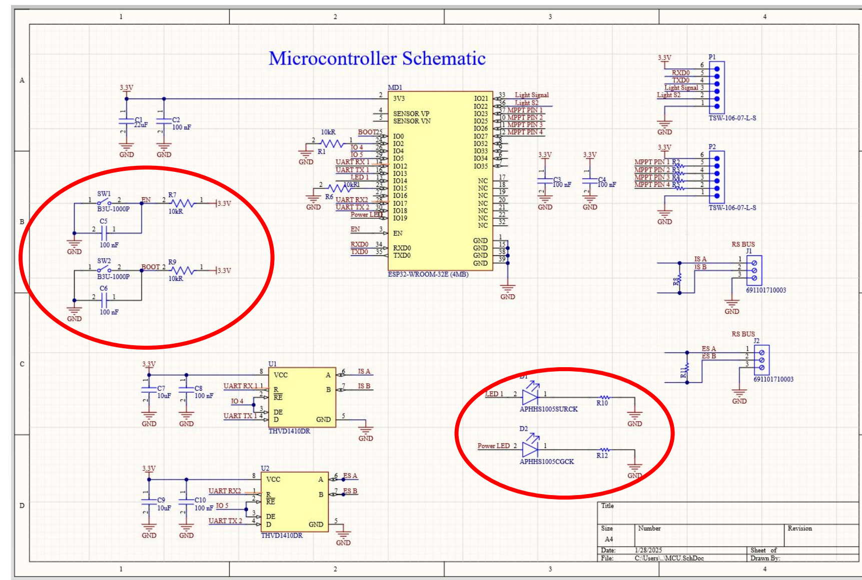
Romi Gilat

Accomplishments since 403 20 hrs of effort	Ongoing progress/problems and plans until the next presentation
Issues: ● MCU was running and flashing - it was damaged due to a fall ● Design Error in Exterior and Interior Sensor connection pins Completed: ● MCU, Exterior & Interior Sensor redesigned	● Finish PCB Schematic for MCU ● Finish PCB Schematic for Exterior and Interior Sensors ● Order components Reach goal ● Finish soldering if PCB arrive

Microcontroller

Romi Gilat





What worked?

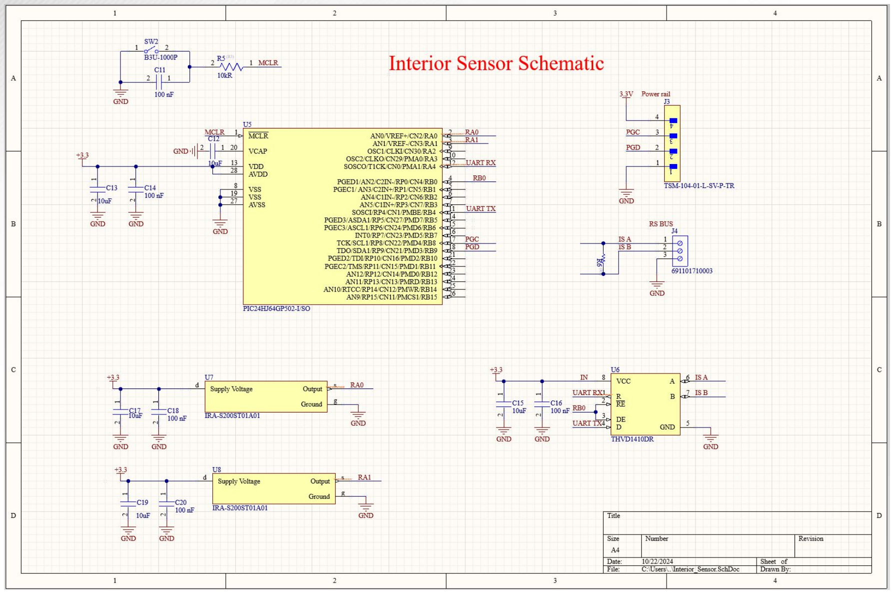
- Device flashed pre fall
- Could handle voltage up to 5V

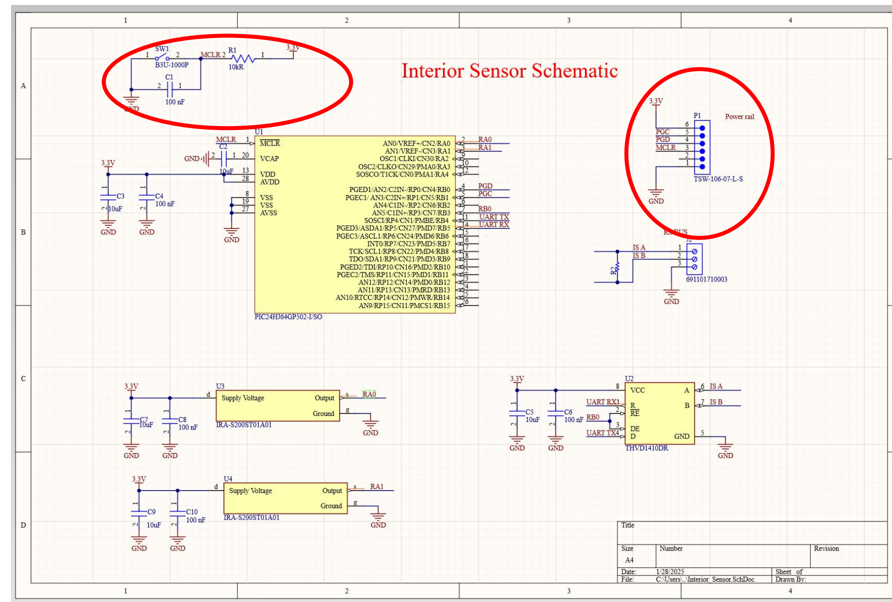
Design Changes

- LED’s to indicate power & connection
- Fixed the Boot & EN tactile pins
- Add screw holes

Sensors

Romi Gilat





Design Changes

- LED’s to indicate power
- Fixed the MCLR tactile pins
- Added MCLR pin connection

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Power Generation

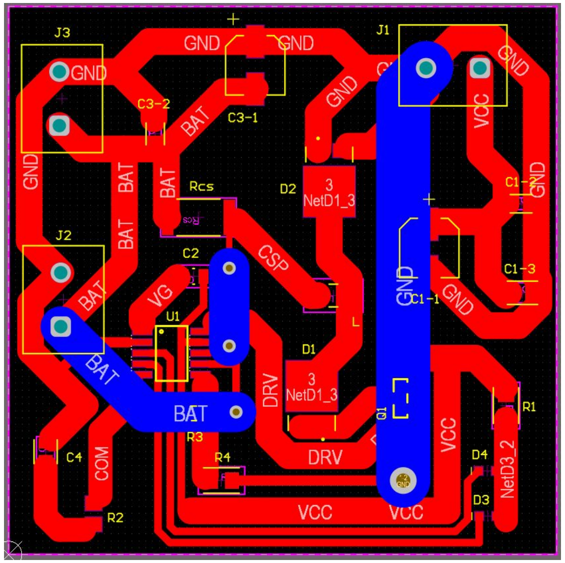
Atahan Bakanyildiz

Accomplishments since 403 10 hrs of effort	Ongoing progress/problems and plans until the next presentation
Identified issue area from 403 demo Replacement parts ordered Power Management Component Researched and Identified to fit requirements of project	Fuel gauge parts to be ordered Power Management design to be made in Altium for order Power Management PCB to be ordered

Power Generation

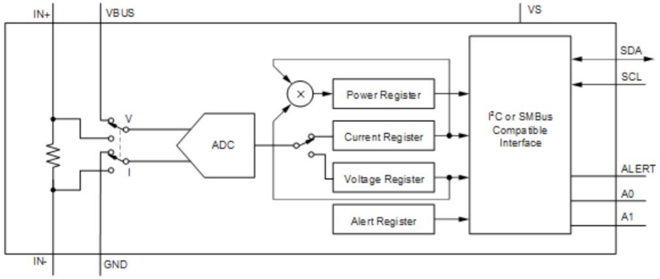
Atahan Bakanyildiz

Previous design had faulty MOSFET and certain resistor values needed to be changed for higher accuracy



Power Management: INA 260

- Voltage Readings
- Current Readings
- I2C Communication



Power Management PCB?

App & Database

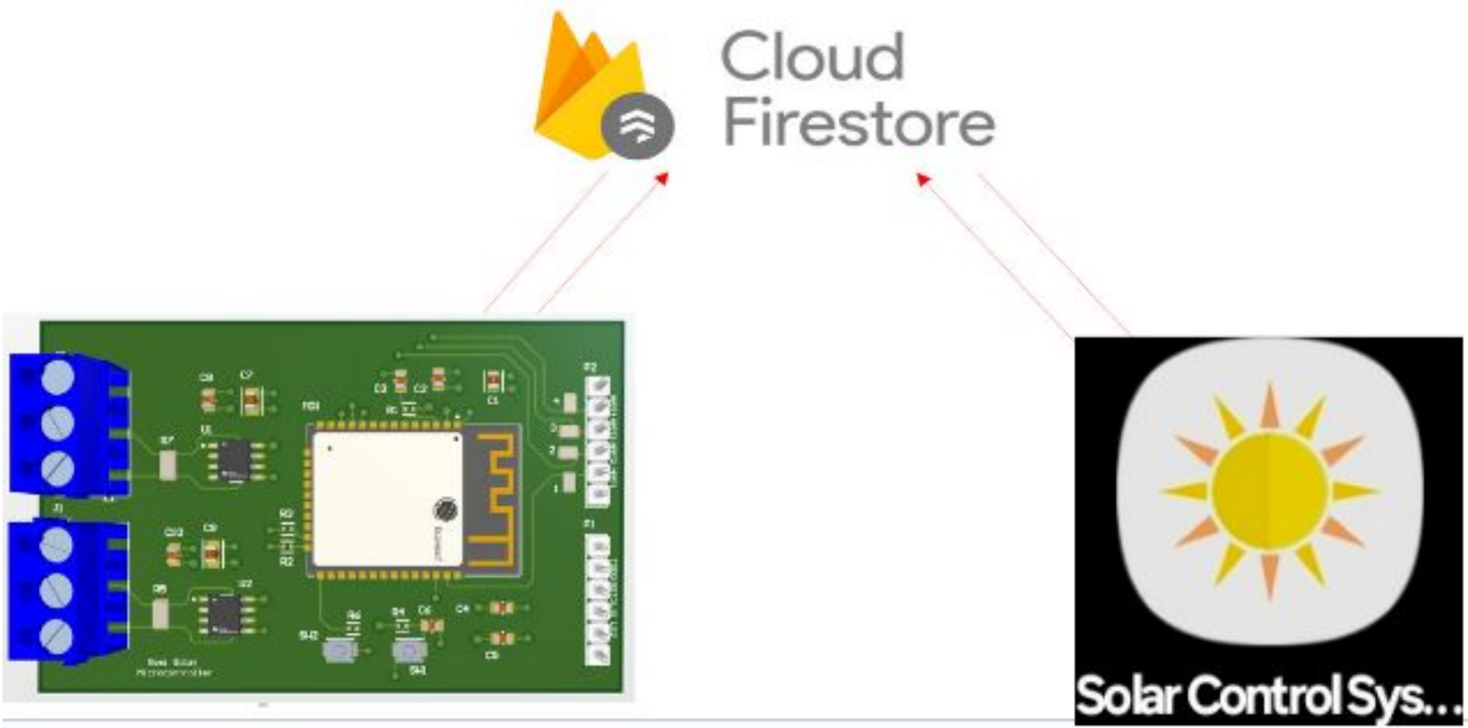
Cedar Maxwell

Accomplishments since 403 8 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Subsystem was fully operational at the end of 403 • Fixed minor bugs in App UI and Database display	• Ongoing development of code for Microcontroller (ESP32) subsystem to integrate with App & Database subsystem (Firebase) • Enable ESP32 to upload data to Firebase and vice versa

App & Database

Cedar Maxwell

Code integrating MCU (ESP32) Subsystem with Firebase is in progress



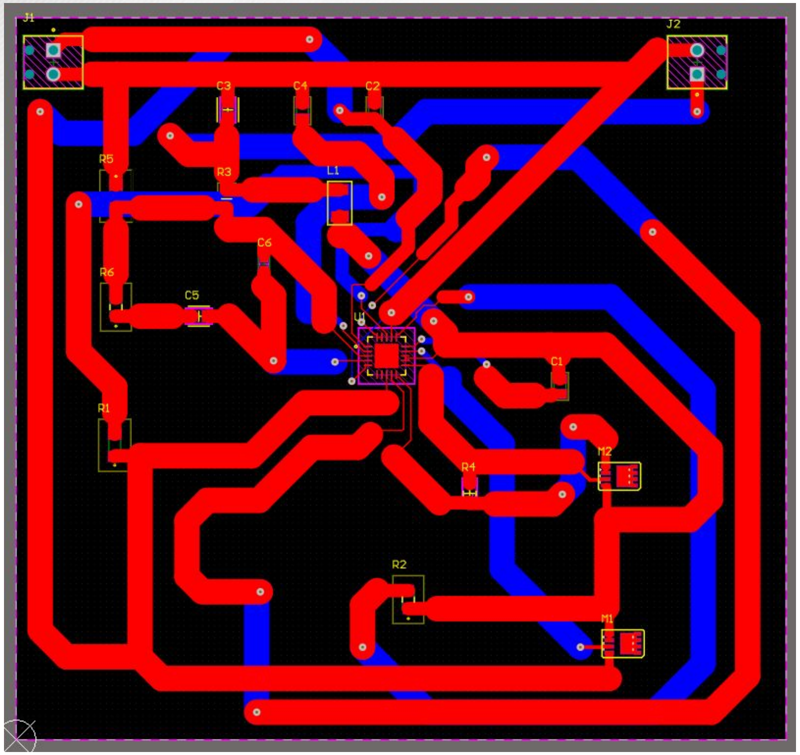
Power Distribution

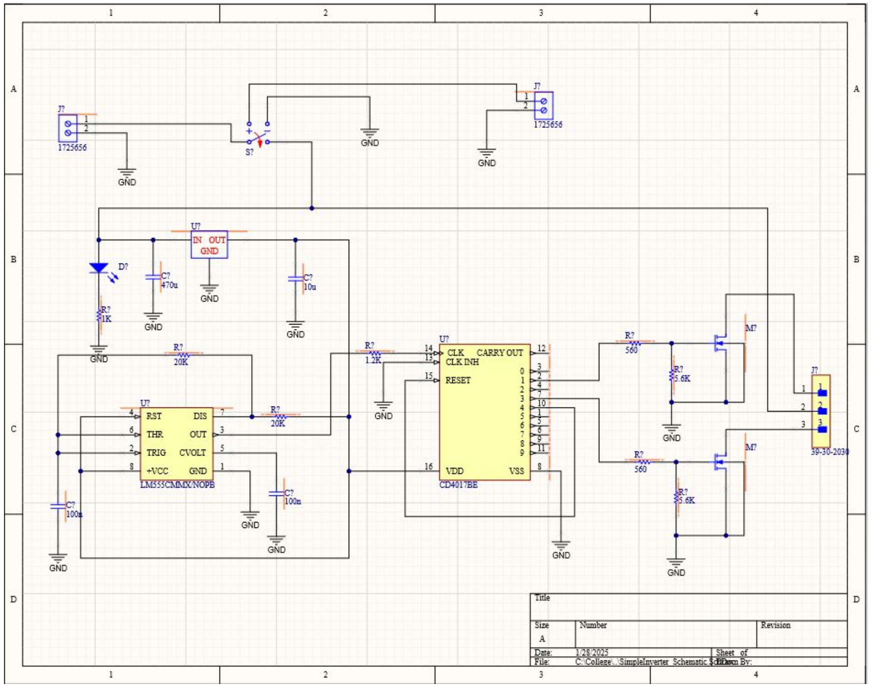
Nicholas Miller

Accomplishments since 403 46 Hours	Ongoing progress/problems and plans until the next presentation
- Corrected Buck Converter concerns. - Conceptually redesigned Simple Modified Sine Wave Inverter. - All necessary PCBs and components have been ordered. - Uploaded relevant material to Github. - Researched relevant integration information.	- Manufacture Simple Modified Sine Wave Inverter. - Continue uploading relevant material and appropriate documentation to Github. - Continue to blueprint integration and 3D design casing for PCB components.

Power Distribution

Nicholas Miller





Parts Ordering Status

MCU & Sensor Subsystem:

- Reorder components
- Reorder PCB for MCU, Interior Sensor and Exterior Sensor

Power Generation

- Reorder components
- Order Power Management PCB

Power Distribution

- Components have been reordered
- PCBs have been reordered
- Buck Converter PCB has arrived (waiting on Simple Modified Sine Wave Inverter PCB)

Execution & Plan

Paragraph #	Test Name	Success Criteria	Methodology	Status	Responsible Engineer(s)
3.2.1.1	Standby Wake-Up Miss Rate	The maximum number of miss trigger incidents within the sensor's field of view will be 15% or less.	The sensors will be trigger tested at different distances to determine % of miss rates	UNTESTED	Romi Gilat
3.2.1.2	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.	Sensors will be trigger tested to check for false positive rates	UNTESTED	Romi Gilat
3.2.1.3	Battery Operating Time	The operating time of the 12V Lead-Acid battery shall be between 10 and 20 hours.	Battery will be tested to check depletion time while the system is running	UNTESTED	Nick Miller
3.2.1.4	Solar Charging Time	The solar charging time shall be between 4 and 6 hours.	This will be tested by fully charging the batteries under full sunlight.	UNTESTED	Atahan
3.2.2.1	System Area	The system area shall include the rooftop, foyer and exterior of a household.	The area of instillation needs to support the solar panels, batteries, and wiring	UNTESTED	Atahan
3.2.2.2	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. The batteries will be done to NEC and be placed within the wall close to the control unit. The control unit will be placed within the wall as well, with wiring connecting the exterior and interior sensor units. These will be mounted on the ceiling to ensure optimal field of view.	Instillation will be done in optimal angel to the sun within area of use	UNTESTED	All
3.2.2.3	Mounting	The automatic solar lighting system will consist of three primary mounted components: solar panels, an indoor sensor with integrated light bulbs, and an outdoor sensor with integrated light bulbs. The interior and exterior lighting units are designed to be relatively lightweight, eliminating the need for substantial structural support, such as interior beams, for installation. Meanwhile, the solar panels will be strategically positioned on the roof to maximize exposure to sunlight.	The mounting will be completed in 404	UNTESTED	All
3.2.3.1	Inputs	The Automatic Solar Lighting System is designed to receive multiple inputs across its different subsystems. The Power Generation subsystem solar power input via the photovoltaic panels. The app receives information on the status of the light as well as various status updates for each of the included subsystems and their performance. The Buck Converter/Inverter subsystem intakes a certain DC voltage and transforms it into a voltage that is suitable for usage with the MCU or the lighting.	These inputs need to consistntly match throughout the system to ensure connectivity	UNTESTED	Atahan, Nick, Romi
3.2.3.1.1	Power Consumption	The system shall consume approximately 18 Watts, 9 Watts per light bulbs.	Power consumption will be tested by running the system on fully charged batteries until they are depleted, measuring the duration it takes for the batteries to be exhausted	UNTESTED	Nick Miller
3.2.3.1.2	Input Voltage Level	The input voltage level shall be +10 VDC to +14 VDC.	Check the voltage outputs using a voltmeter.	UNTESTED	Nick Miller
3.2.3.1.3	External Commands	The Automatic Solar Lighting System shall document all external commands in the appropriate ICD.	These commands will be verified through the IDC using testing	UNTESTED	Cedar Maxwell
3.2.3.2.1	Data Output	The Automatic Solar Lighting System will output the status of the porch and foyer lights by means of the mobile application.	This will be tested by turning on the light and seeing if the trigger is sent to the app	UNTESTED	Cedar Maxwell
3.2.3.2.2	Diagnostic Output	The MCU will transmit diagnostic data to the app for display.	The MCU and app will display mutliple outputs based on different tests	UNTESTED	Cedar Maxwell, Romi Gilat
3.2.3.2.3	Connectors	The Automatic Solar Lighting System will use the American National Standard for Electrical Connectors ANSI C119.6-2011.	connectors will be completed in 404	UNTESTED	All
3.2.3.2.4	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).	Electrical wiring will be done in 404	UNTESTED	All
3.2.4.1	Altitude	The Automatic Solar Lighting System shall be able to operate efficiently at altitudes around 300 feet.	This was decided based on normal house height and texas altitude	UNTESTED	Nick, Romi, Atahan
3.2.4.2	Thermal	The Automatic Solar Lighting System shall be able to operate efficiently at temperatures ranging from 0°C to 70°C. 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.	This was decided based on compoenets picked	UNTESTED	Nick, Romi, Atahan
3.2.4.3	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.	This was decided based on Texas's weather forcaste	UNTESTED	All

Thank you!