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ENGINEERING
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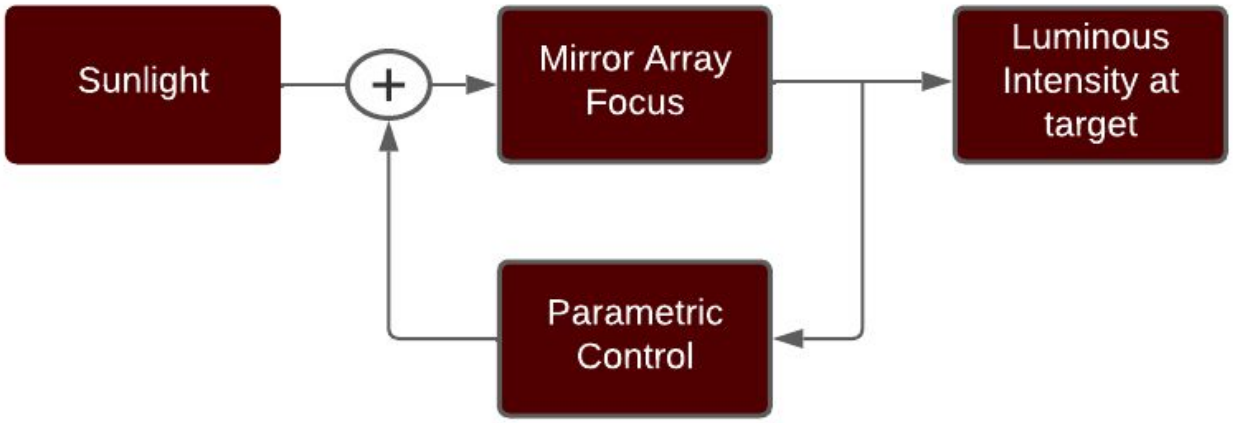
ECEN 404 Update #1
Heliostat Control Tracking Team #66

Jordan George, Samuel Dixon
Sponsor: Dr. Madsen
TA: Dalton Cyr

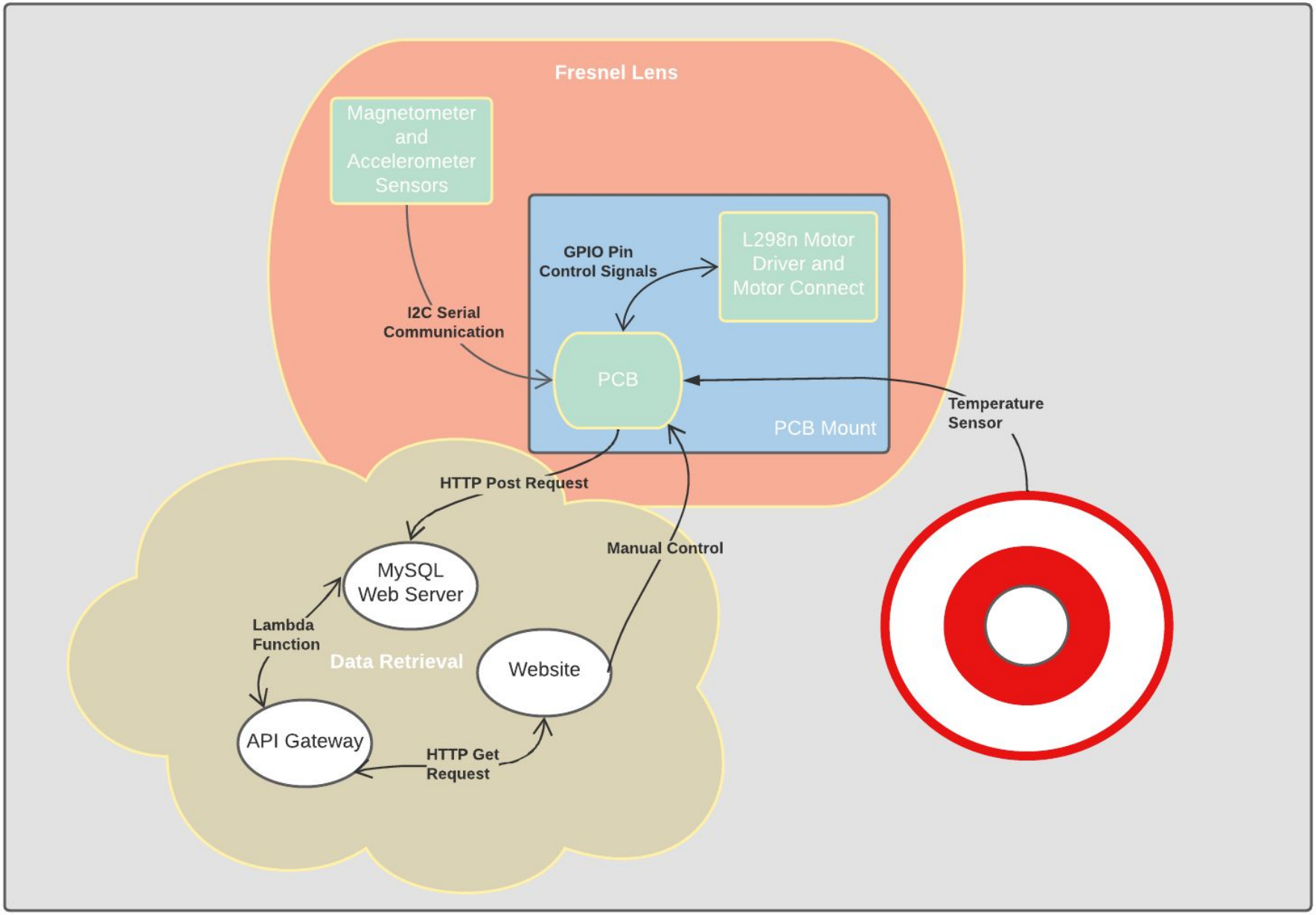
Executive Summary

Problem Statement:

- Developing a Heliostat to track and reflect the sun's light on a target
  - Used in R&D purposes to accelerate the transition to renewable energy sources utilizing IoT technologies
  - Provide increased ease of using software and smaller local model



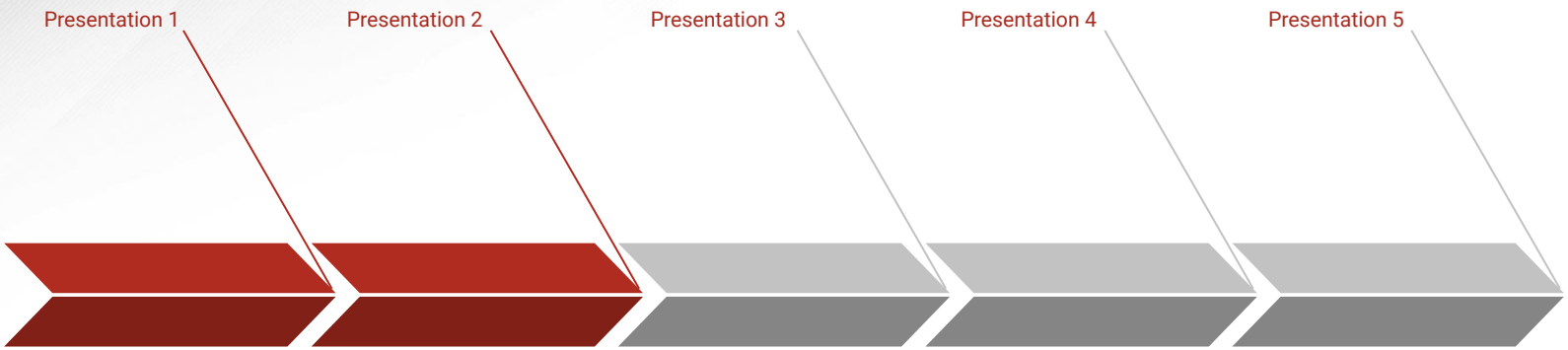
System Overview



Major Project Changes Since 403

- Repartitioned one of the subsystems since the loss of a team member
- Phone App ⇨ Web App
  - Sensor data
    - NoSQL ⇨ MySQL

Project Timeline



403 Recovery

Repartitioning Subsystems, and finalizing individual subsystems

Beginning Integration

Flashing and testing validity of code onto PCB and move motors through program by programmable amount

Integration Testing and Debugging

Verify I2C sensor data and motor control methodology

Continued Test and Documentation

Continuing integration level test and validating functional system requirements

Final Validation

Run system to make sure it is demo ready.

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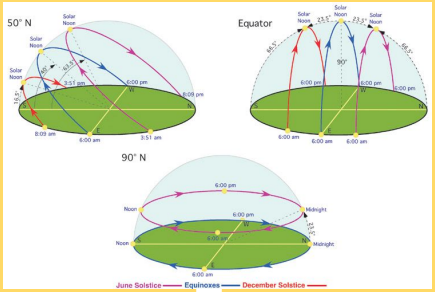
Jordan + Sam

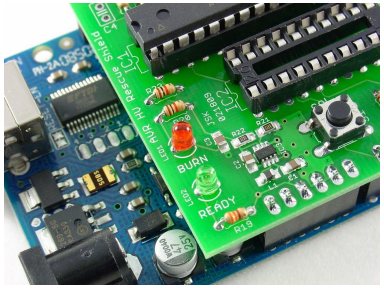
Tracking Control Software



- Guides the mirror to follow the sun throughout the day
- Appropriate angles to reflect the sunlight to the data collection
- Physical array to hold the mirrors in a parabolic shape

Jordan

PCB Layout

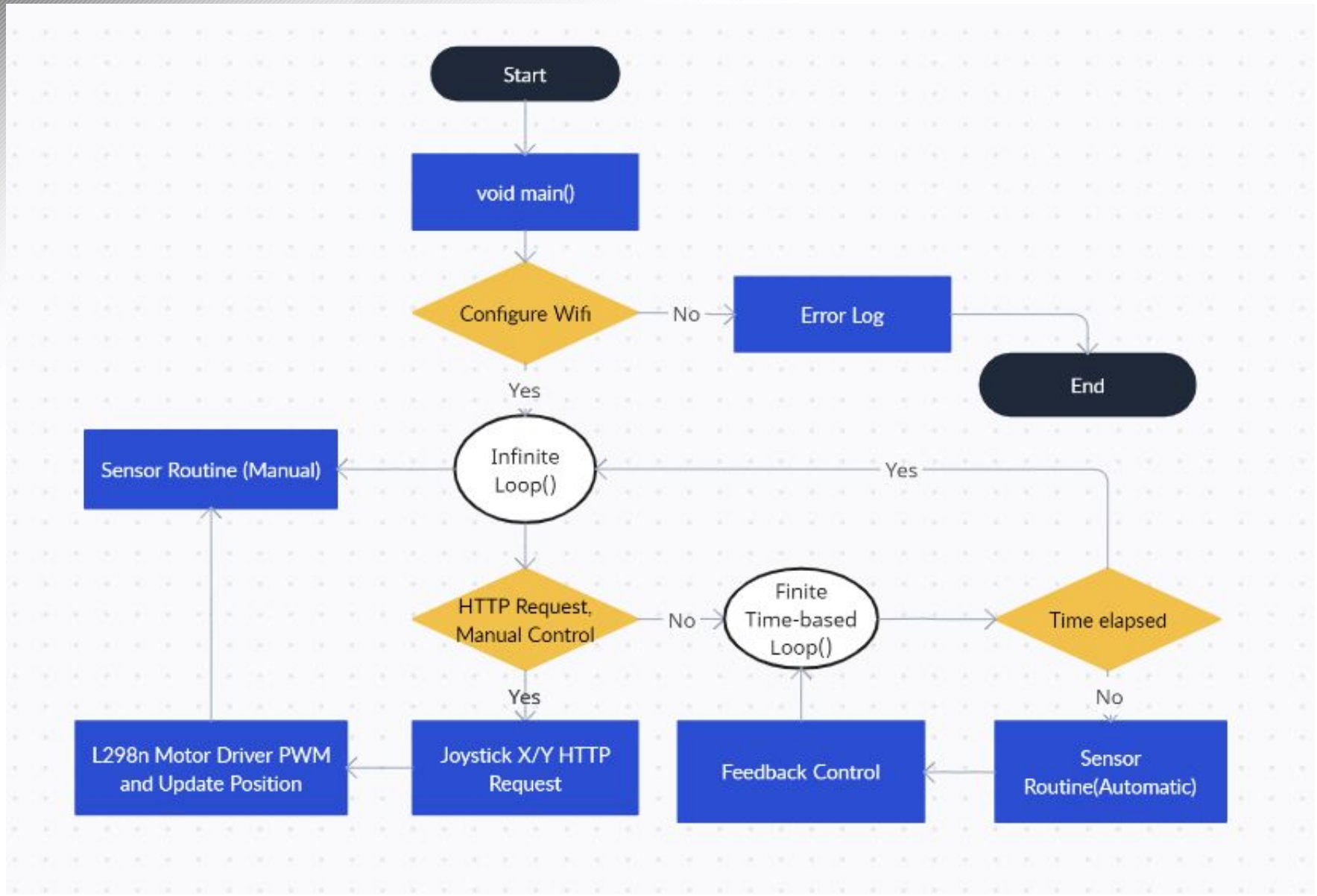


- Organizing circuit block level components and interfacing these with ESP32 WROOM Microprocessor
- Doing layout of components in orderly fashion

Sam

Data Visualization

- Providing real time data analytics and insights for system feedback and functionality
- Human machine interface for interacting with the motors


Start
void main()
Configure Wifi
No
Error Log
End
Yes
Infinite Loop()
Sensor Routine (Manual)
Yes
HTTP Request, Manual Control
No
Finite Time-based Loop()
Time elapsed
Yes
No
L298n Motor Driver PWM and Update Position
Joystick X/Y HTTP Request
Feedback Control
Sensor Routine(Automatic)

Recovery for Motor Control Tracking

Tracking Control: (Jordan George)

- Finalize tracking control algorithm to allow the motors to rotate and tilt based on the sun's location
- Using ESP32 on PCB to communicate with L298N motor driver

Sensors: (Samuel Dixon)

- Configure I2C bus serial communication with sensors
- Send data to AWS RDS (MySQL Web Server) via post request

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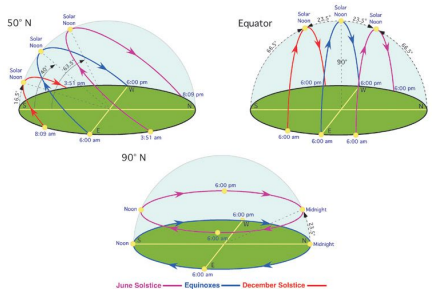
Tracking Control Software



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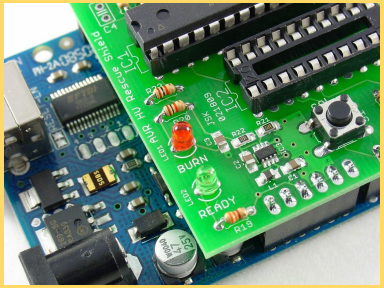

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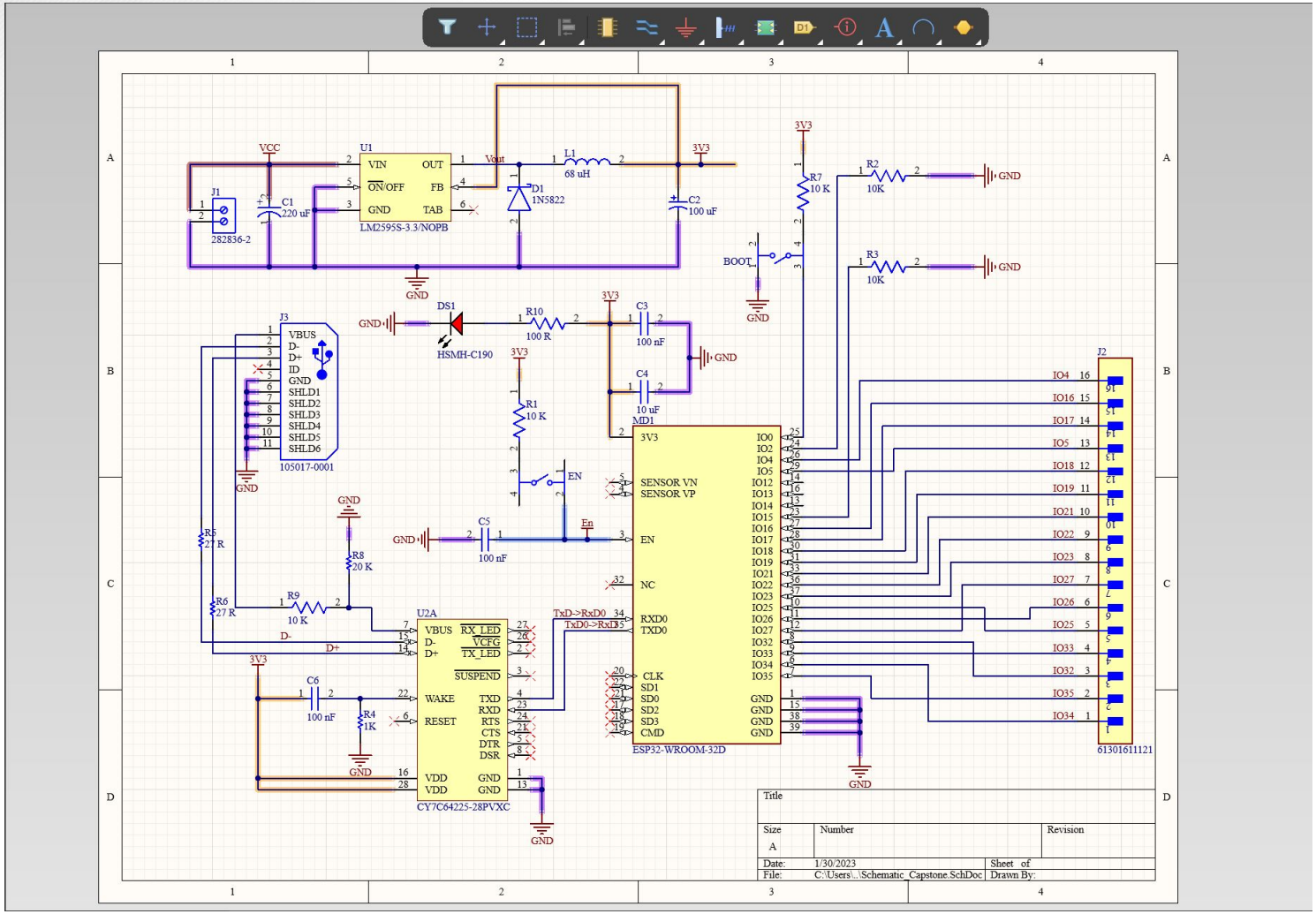
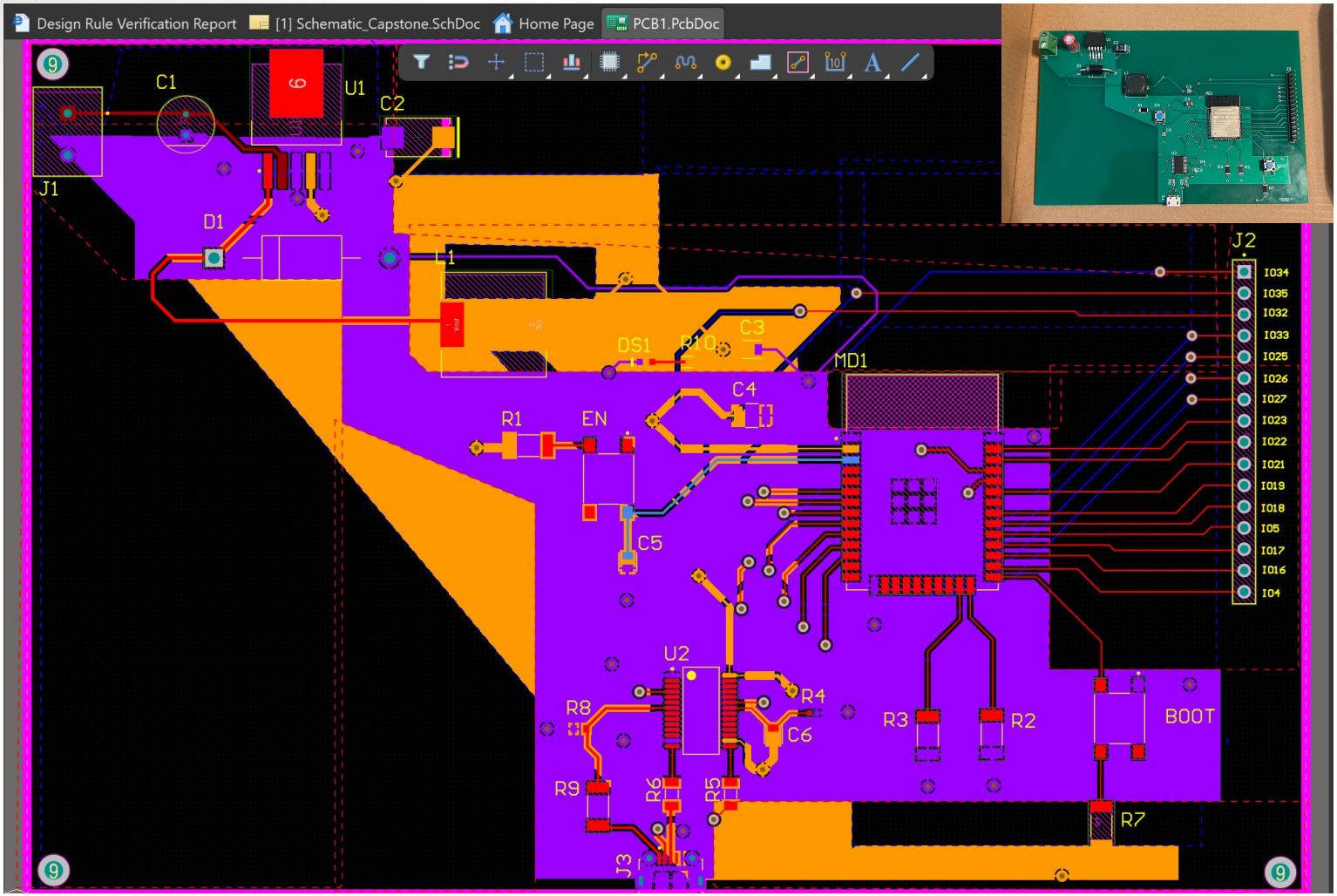
PCB Subsystem

- Since 403: 7 hours of effort
- Power supply and regulator of PCB worked as expected and was validated in 403
- Need to reorder PCB since the USB connection is not working

PCB Schematic



PCB Layout


Design Rule Verification Report
[1] Schematic_Capstone.SchDoc
Home Page
PCB1.PcbDoc
C1
U1
C2
J1
D1
L1
DS1
R10
C3
MD1
C4
R1
EN
C5
J2
IO34
IO35
IO32
IO33
IO25
IO26
IO27
IO23
IO22
IO21
IO19
IO18
IO5
IO17
IO16
IO4
U2
R8
R4
C6
R3
R2
BOOT
R9
R6
R5
R7
J3

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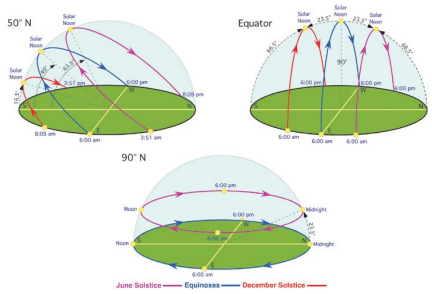
Tracking Control Software



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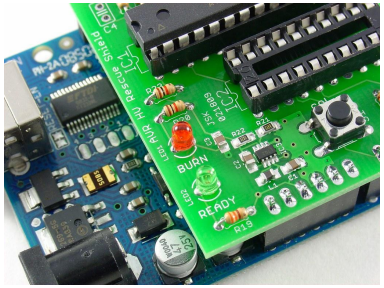

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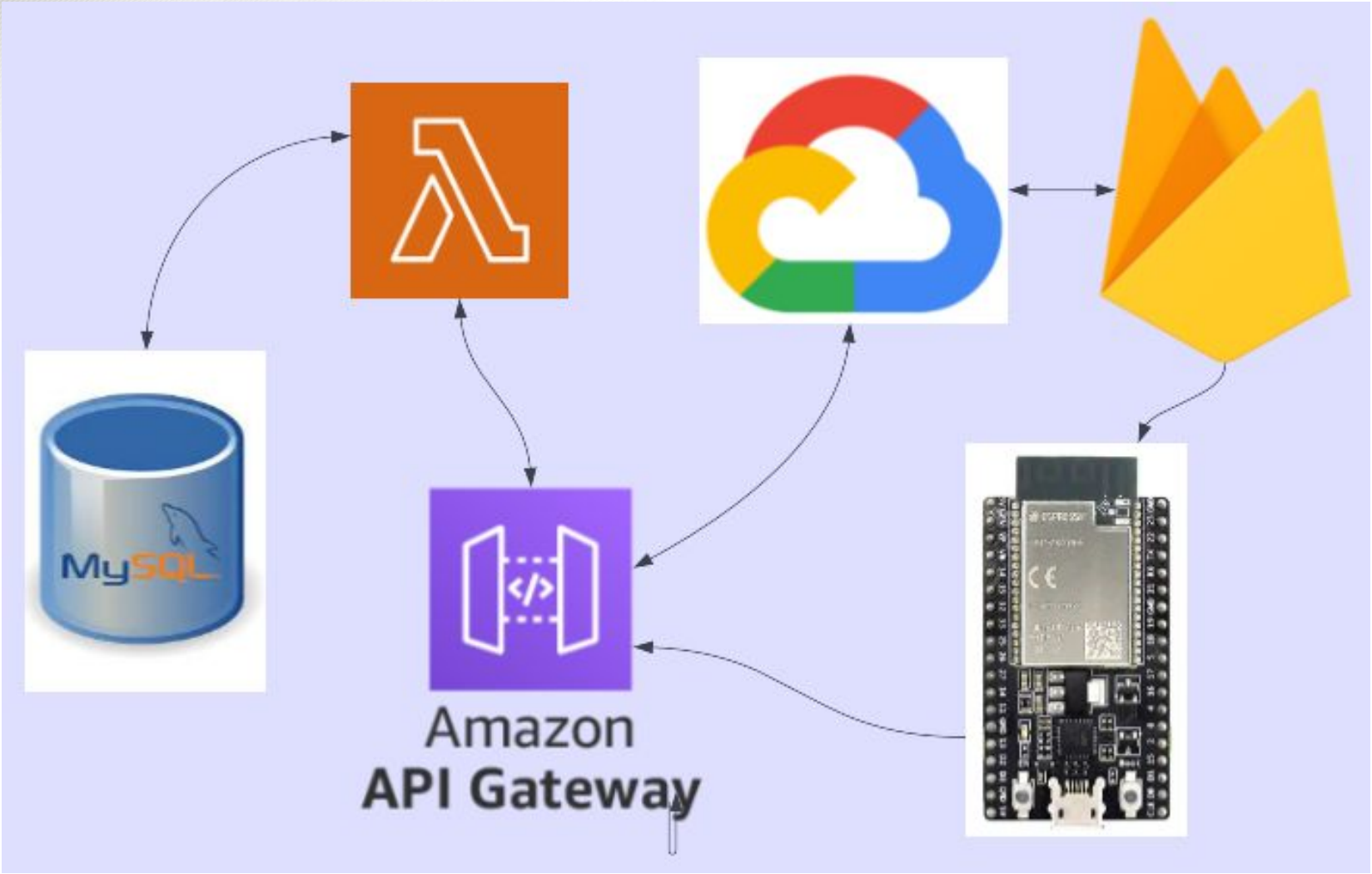
Data Visualization

- Pivoted user interface and database dashboard to Web Application from Phone Application
- ISR Routine for motor control design and test
- Connecting ESP32 to eduroam wifi and test POST/GET HTTP requests in Espressif IDE
- Changed from NoSQL database to MySQL database for storing sensor data
  - NoSQL still used as endpoint for joystick x/y motor control parameters

Data Visualization Subsystem



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Heliostat Controls Web Data

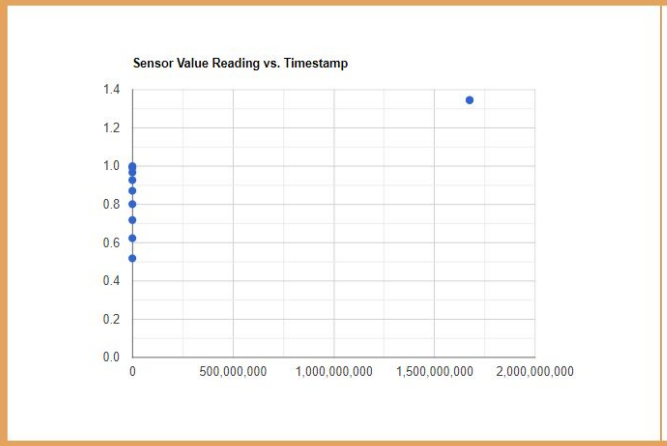
Data Query and Table | Historical Capture | Manual Control | Buildable

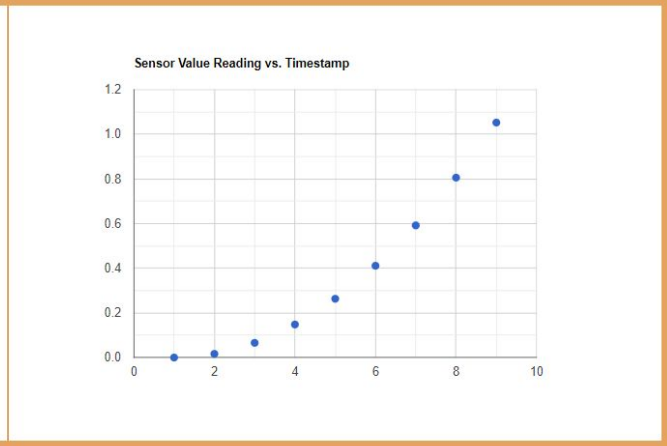
Sensor
Timestamp 0.0 1,000.0

	Sensor	Reading	Timestamp
1	Magnetometer1	1	1
2	Magnetometer2	0	1
3	Magnetometer1	0.992	2
4	Magnetometer2	0.016	2
5	Magnetometer1	0.967	3
6	Magnetometer2	0.066	3
7	Magnetometer1	0.927	4
8	Magnetometer2	0.148	4
9	Magnetometer1	0.871	5
10	Magnetometer2	0.263	5
11	Magnetometer1	0.801	6
12	Magnetometer2	0.411	6
13	Magnetometer1	0.718	7
14	Magnetometer2	0.592	7
15	Magnetometer1	0.623	8
16	Magnetometer2	0.806	8
17	Magnetometer1	0.518	9
18	Magnetometer2	1.052	9

Heliostat Controls Web Data

Data Query and Table | Historical Capture | Manual Control | Buildable





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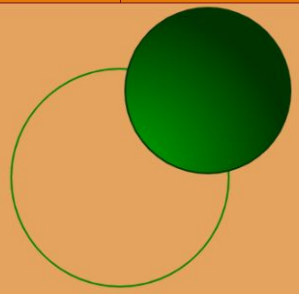
Heliostat Controls Web Data

Data Query and Table	Historical Capture	Manual Control	Buildable



Direction: NE
Current X: 101
Current Y: 100

Validation Plan

Subsystem	Date	Test Description	Status
Data Visualization	1/23/2023	Sending data to and from the microcontroller via HTTP POST / GET Request	Complete
Integration	1/23/2023	Flashing test program onto PCB board from Espressif IDE	In-progress
Tracking Controls	2/6/2023	L2987n Motor Driver Configuration and testing to move motors, I2C configuration and sensor readings	Not Started
Tracking Controls	2/13/2023	Azimuth/Elevation Angle computation to move motors to computed azimuth and elevation angle	Not Started
Integration	2/20/2023	Mounting motors to move fresnel lens fixed distance and store data on a periodic interval, verify data correctly stored for sensor and test manual operation	Not Started
Integration	2/27/2023	Testing computation of azimuth and elevation angle at time intervals and specified latititude and logititude to track and move lens with sun	Not Started
Integration	3/6/2023	Integrate accelerometer sensor for further feedback control methodology	Not Started
Integration	3/20/2023	Test accelerometer, magnetometer, and temperature sensor mesh with motor movement	Not Started
Integration	3/27/2023	Test manual control operation via website and sensor routine corresponding to manual operation	Not Started
Integration	4/3/2023	Fully automatic operating mode test during day for 8 hours and ensure operating modes correct	Not Started
Integration	4/17/2023	Prepare for demo and final debug - video recording of progress	Not Started

Q&A

Thank you for listening to the Heliostat Control Tracking Presentation