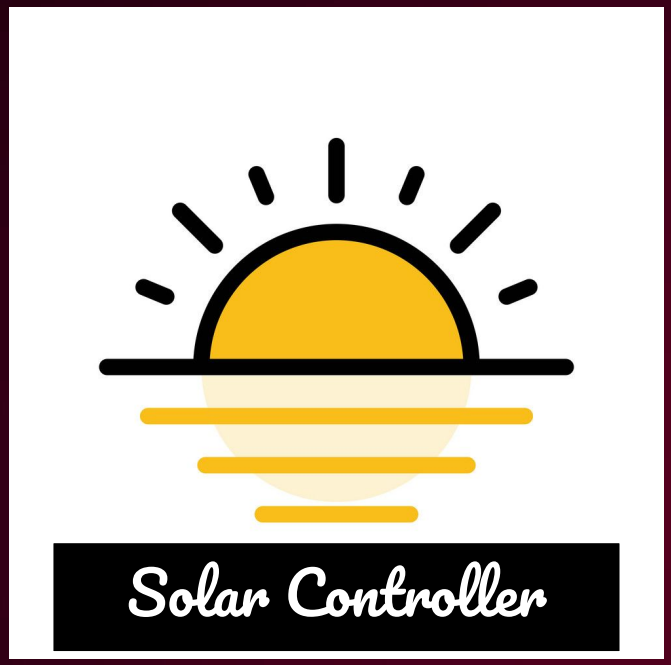


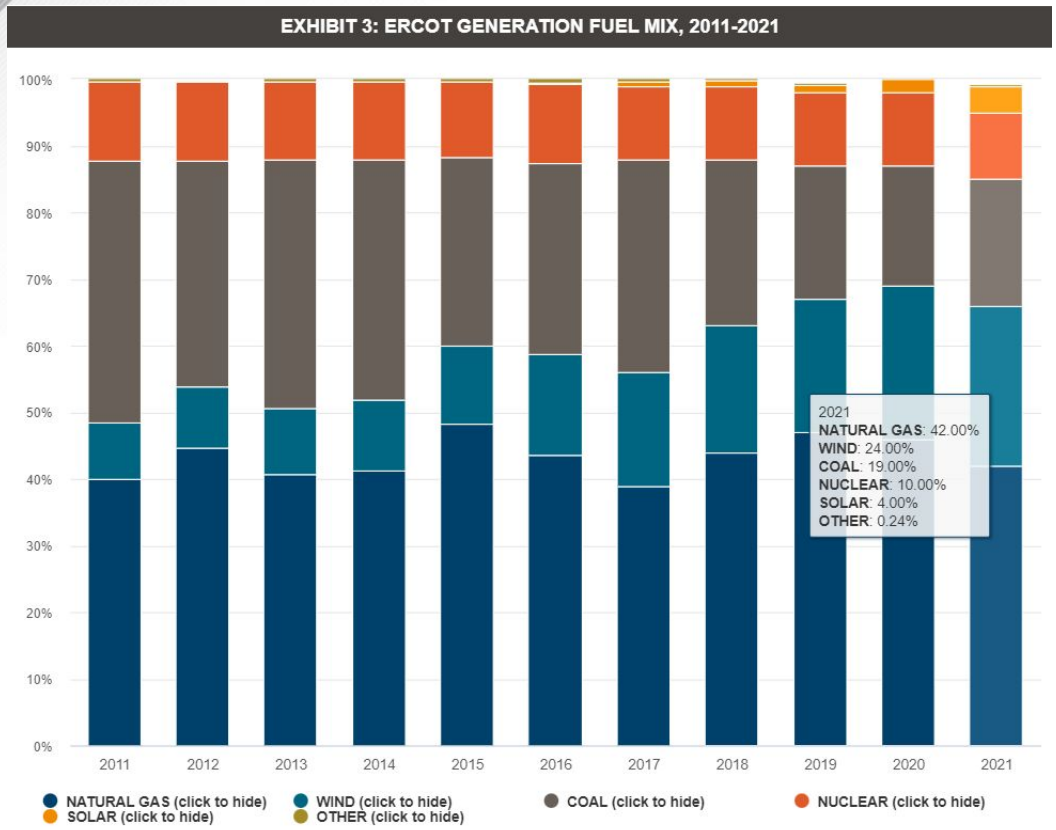

Dwight Look College of ENGINEERING
TEXAS A&M UNIVERSITY

# ECEN 404 Update #5
# Heliostat Control Tracking Team #66

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

# Problem Statement

- Necessity for rapid change of energy source partition
- Done on basis of conscious consumption and environmental need
- Apparent growth, but room for improvement




Note: Figures may not sum due to rounding.

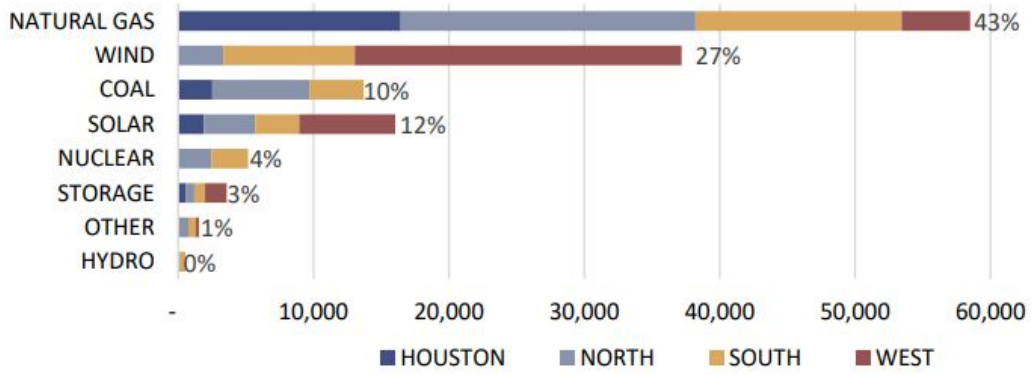
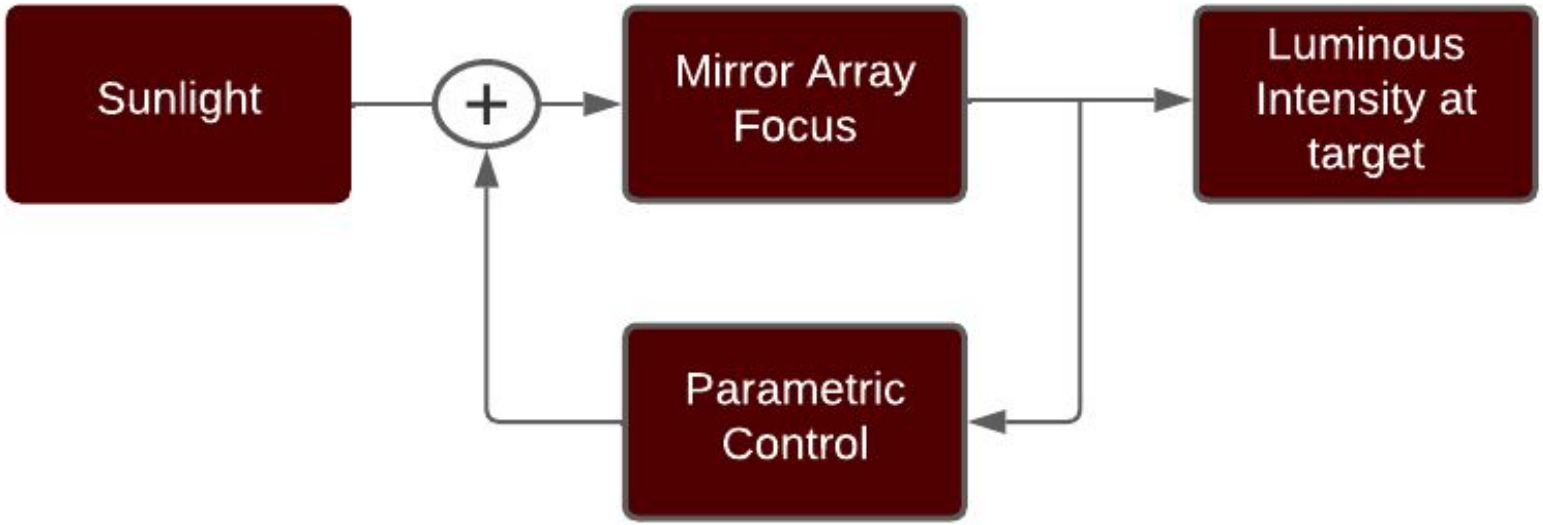



**Figure 2 ERCOT Installed Capacity by Fuel Type (MW) – 2022**

*Images Adapted from Ercot Case Study

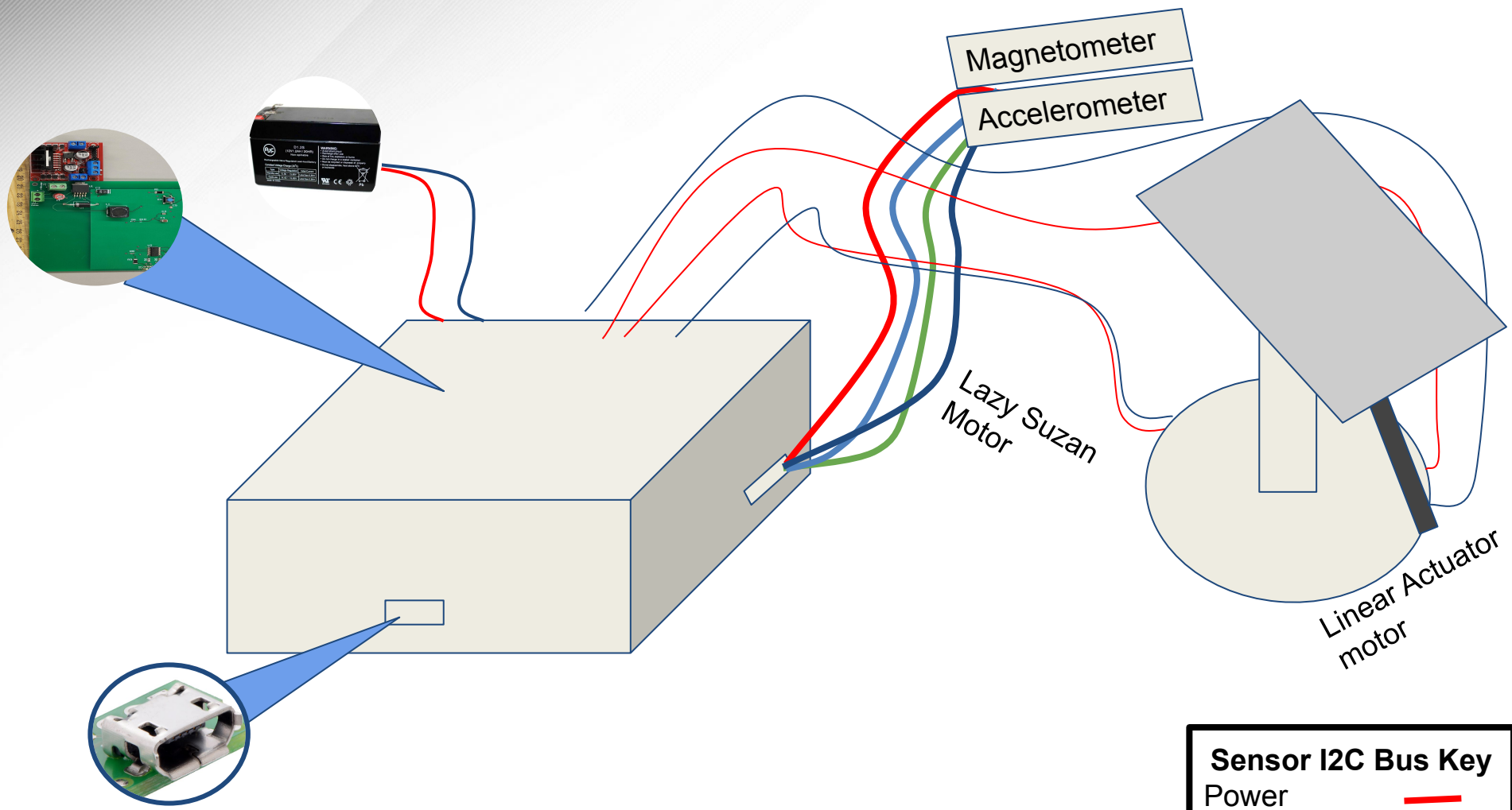
# Executive Summary

Track the Sun's movements with feedback parameters through a Fresnel Lens and focus light onto a target

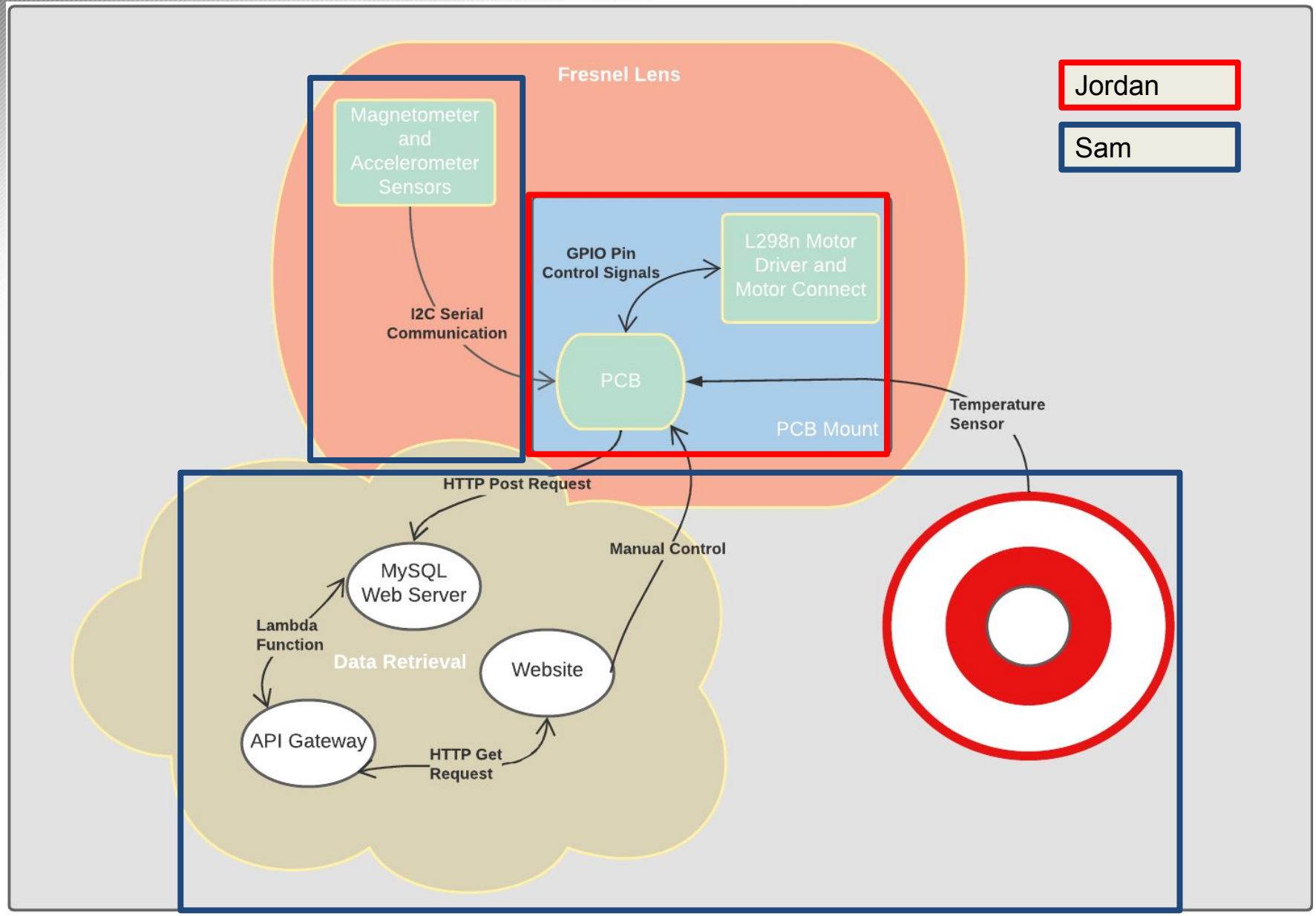


Dwight Look College of ENGINEERING
TEXAS A&M UNIVERSITY

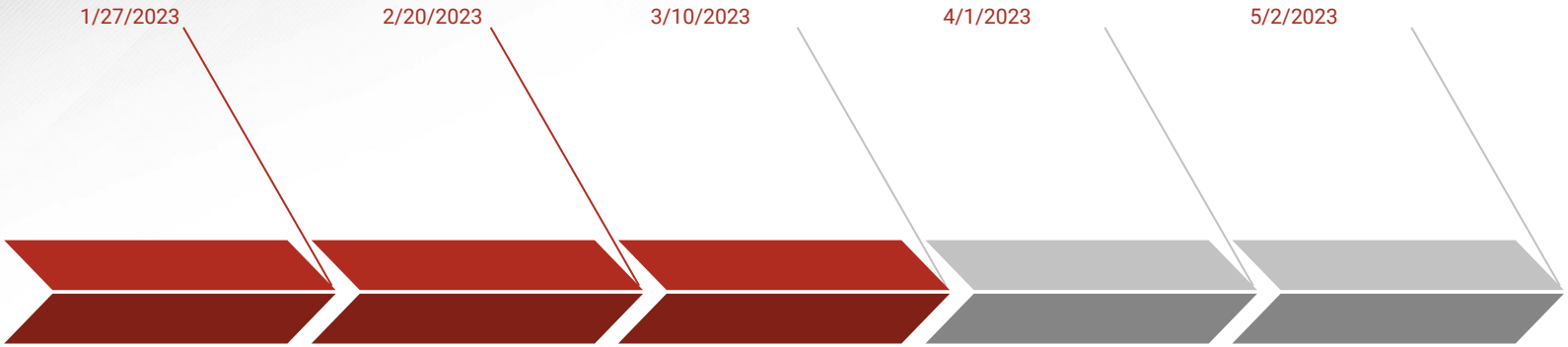
# System Overview



# System Owners



# Project Timeline




### 403 Recovery

Repartitioning Subsystems, and finalizing individual subsystems

### Beginning Integration

Finishing 403 recovery and testing functionality of I2C serial communication and tracking controls algorithm with motors

### Demonstration to Sponsor

Demonstrate microprocessor-based control of rotation and tilt motion to a specific direction of the calculated sun's position, with magnetometer measurement of azimuth and elevation with an accelerometer measurement.

### Subsystem integration

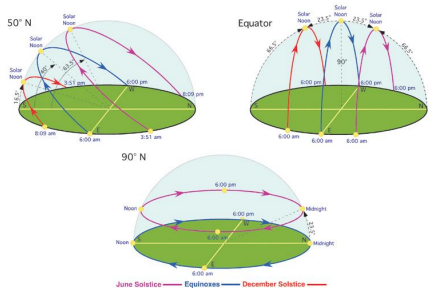
Continue to refine automatic tracking algorithm if needed as well as further debugging to prepare for the final demo.

### Final Validation

Full testing and evaluation of performance capability, evaluation of tracking accuracy, full documentation of hardware design, software programming and data pathway for transition to future researcher(s)

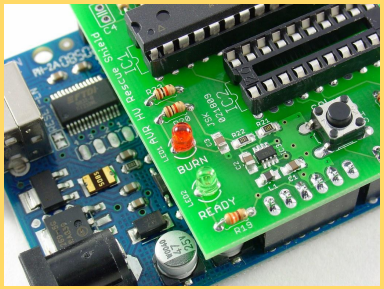
## Jordan + Sam

Tracking Control Software




## Jordan

PCB Layout




## Sam

Data Visualization

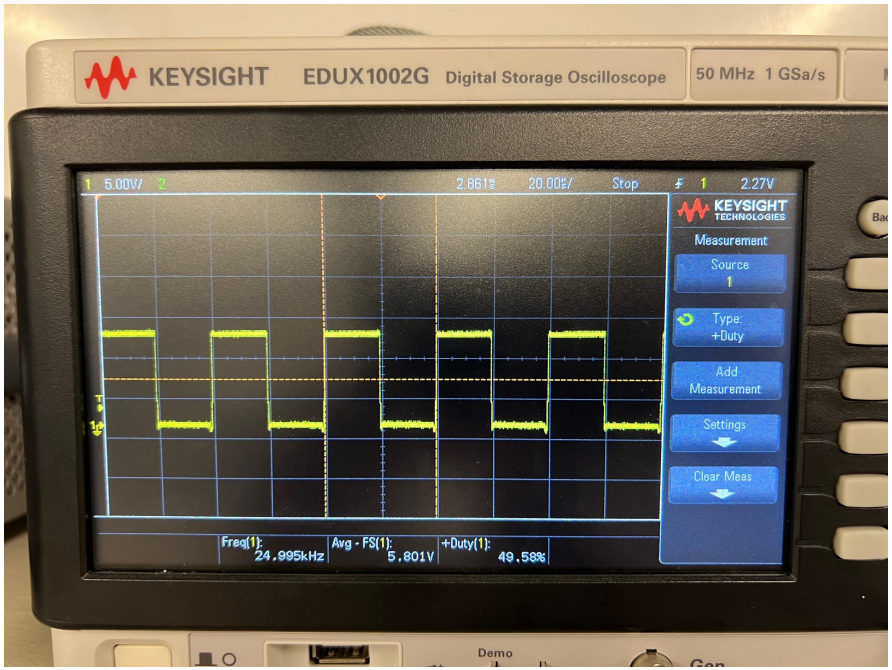
# PCB & Tracking Control Subsystem

**Jordan George**

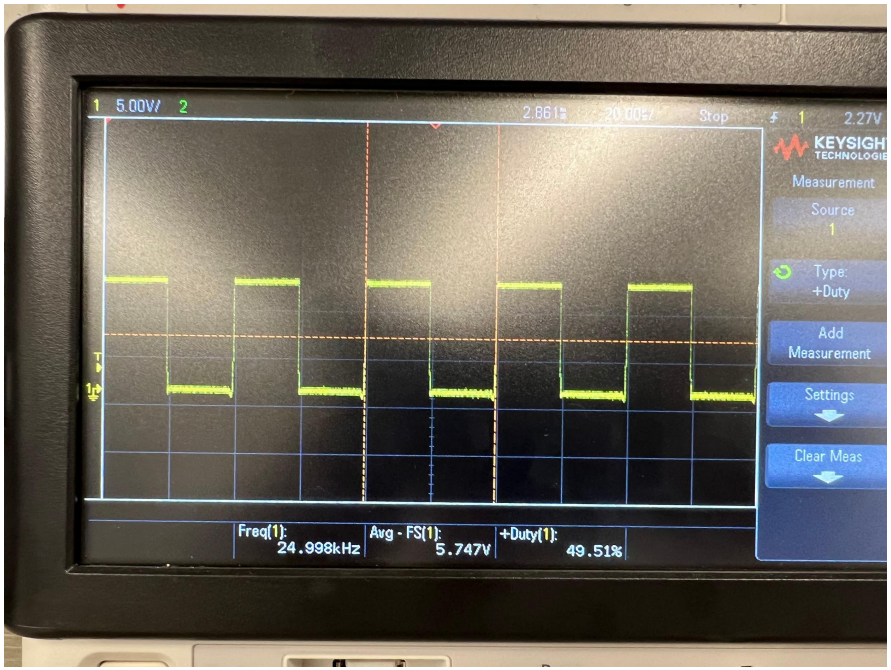
| Completed in the last 2 weeks<br>Hours of Effort: 25 hours | Ongoing progress and goals for next 2 weeks |
|---|---|
| • USB port fixed<br>• Able to move test motors with a scaling factor and update every 10 minutes<br>• Was able to move the tilt motor on the actual system with PCB, motor driver, and code | • Getting the system rotation motor moving<br>• Get scaling factor of both system motors |

# Tracking Control Subsystem

- Readings of PWMs at both motor terminals at 50% duty cycle:



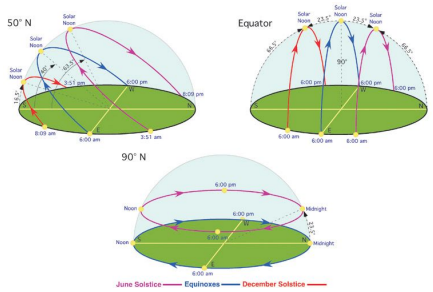

Motor 1 Terminal




Motor 2 Terminal

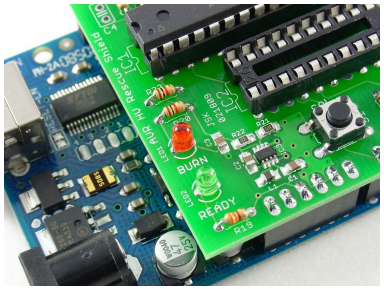
## Jordan + Sam

Tracking Control Software




## Jordan

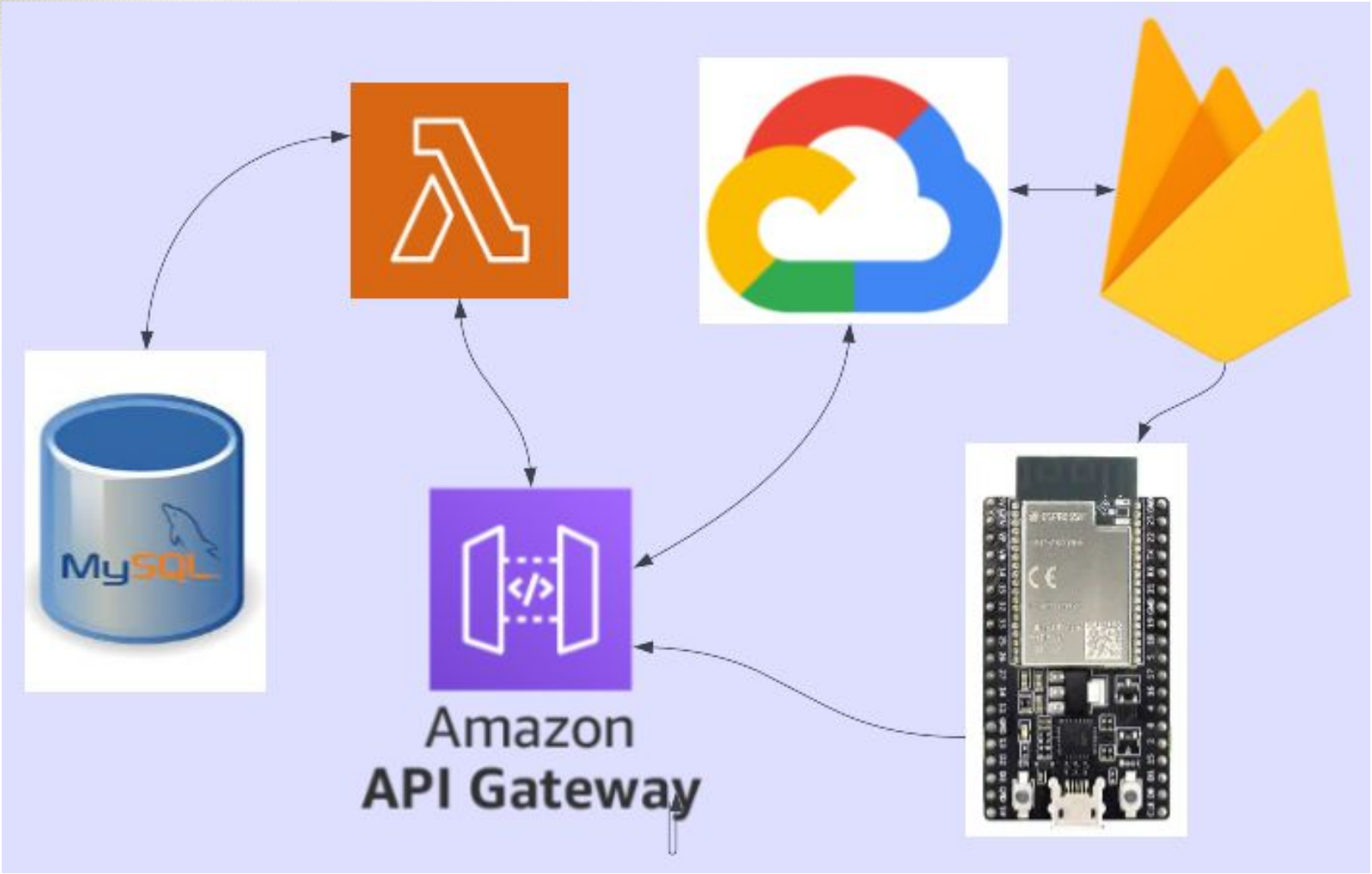
PCB Layout




## Sam

Data Visualization + UI

# Data Visualization Subsystem



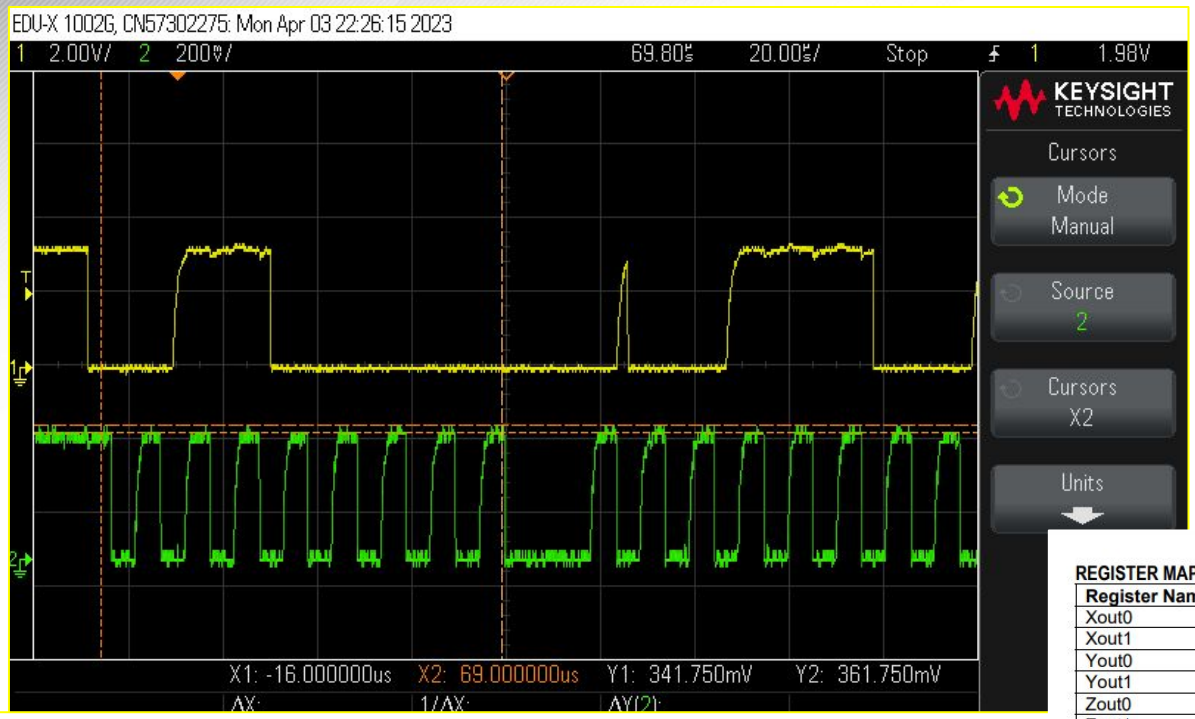
Dwight Look College of ENGINEERING
TEXAS A&M UNIVERSITY

# Data Visualization and I2C Sensor Subsystem

**Samuel Dixon**

| Completed in the last 2 weeks<br>Hours of Effort: 30 | Ongoing progress and goals for next 2 weeks |
|---|---|
| • Identified issue with magnetometer and debug | • Identified issue with magnetometer and debug<br>• Integrate website to parse MySQL data via GET request<br>• CAD Modelling and 3D print for system mounting |

# Magnetometer Debug




**REGISTER DETAILS**

**Xout0, Xout1, Xout2**

| **Xout0** | 7 | 6 | 5 | 4 | 3 | 2 | 1 | |
|---|---|---|---|---|---|---|---|---|
| Addr: 00H | Xout[19:12] | | | | | | | |
| Mode | Read-only | | | | | | | |

| **Xout1** | 7 | 6 | 5 | 4 | 3 | 2 | 1 | |
|---|---|---|---|---|---|---|---|---|
| Addr: 01H | Xout[11:4] | | | | | | | |
| Mode | Read-only | | | | | | | |

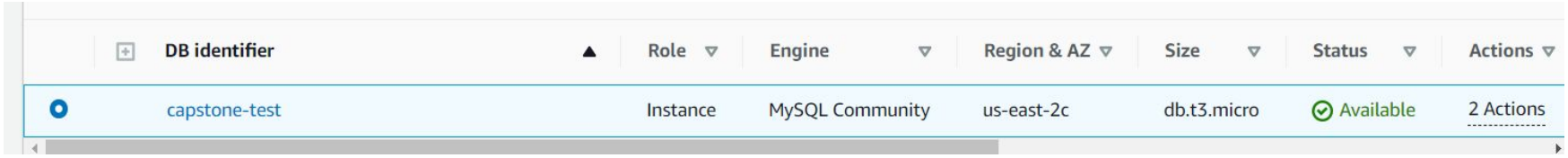
| **Xout2** | 7 | 6 | 5 | 4 | 3 | 2 | 1 | |
|---|---|---|---|---|---|---|---|---|
| Addr: 06H | Xout[3:0] | | | | 0 | 0 | 0 | |
| Mode | Read-only | | | | | | | |

**REGISTER MAP**

| Register Name | Address (HEX) | Description |
|---|---|---|
| Xout0 | 00H | Xout[19:12] |
| Xout1 | 01H | Xout[11:4] |
| Yout0 | 02H | Yout[19:12] |
| Yout1 | 03H | Yout[11:4] |
| Zout0 | 04H | Zout[19:12] |
| Zout1 | 05H | Zout[11:4] |
| Xout2 | 06H | Xout[3:0] |
| Yout2 | 07H | Yout[3:0] |
| Zout2 | 08H | Zout[3:0] |
| Tout | 09H | Temperature output |
| Status1 | 18H | Device status1 |
| ODR | 1AH | Output data rate |
| Internal control 0 | 1BH | Control register 0 |
| Internal control 1 | 1CH | Control register 1 |
| Internal control 2 | 1DH | Control register 2 |
| ST_X_TH | 1EH | X-axis selftest threshold |
| ST_Y_TH | 1FH | Y-axis selftest threshold |
| ST_Z_TH | 20H | Z-axis selftest threshold |
| ST_X | 27H | X-axis selftest set value |
| ST_Y | 28H | Y-axis selftest set value |
| ST_Z | 29H | Z-axis selftest set value |
| Product ID | 39H | Product ID |

# API Gateway Endpoint with backend


```
{"1": {"name": "Accelerometer1", "x": 0.5, "y": 3.1, "z": 9.5, "ae": 28.5, "ce": -85.1, "t": 167
23.7}, "3": {"name": "Accelerometer1", "x": 0.5, "y": 3.1, "z": 9.5, "ae": 30.0, "ce": -85.1, "t
"t": 23.7}, "5": {"name": "Accelerometer1", "x": 0.5, "y": 3.1, "z": 9.5, "ae": 30.6, "ce": -85.
119.7, "t": 23.5}, "7": {"name": "Accelerometer1", "x": 0.6, "y": 3.1, "z": 9.5, "ae": 31.1, "ce
"ca": 120.2, "t": 23.5}, "9": {"name": "Accelerometer1", "x": 0.6, "y": 3.0, "z": 9.6, "ae": 31.
0.0, "ca": 120.8, "t": 23.6}, "11": {"name": "Accelerometer1", "x": 0.3, "y": 2.9, "z": 9.6, "ae
"aa": 0.0, "ca": 121.4, "t": 24.0}, "13": {"name": "Accelerometer1", "x": 0.3, "y": 2.9, "z": 9.
32115.0, "aa": 0.0, "ca": 122.0, "t": 24.0}, "15": {"name": "Accelerometer1", "x": 0.3, "y": 2.9
"z": 32106.0, "aa": 0.0, "ca": 122.6, "t": 23.7}, "17": {"name": "Accelerometer1", "x": 0.9, "y"
32138.0, "z": 32138.0, "aa": 0.0, "ca": 123.2, "t": 24.1}, "19": {"name": "Accelerometer1", "x":
"y": 32110.0, "z": 32110.0, "aa": 0.0, "ca": 123.8, "t": 23.7}}
```

| DB identifier | Role | Engine | Region & AZ | Size | Status | Actions |
|---|---|---|---|---|---|---|
| capstone-test | Instance | MySQL Community | us-east-2c | db.t3.micro | Available | 2 Actions |

# Validation Plan

| FSR Requirement | Subsystem | Date | Test Description | Status |
|---|---|---|---|---|
| 3.2.2.5 | Data Visualization | 1/23/2023 | Sending json formatted data to and from the microcontroller via HTTP POST / GET Request | Complete |
| 3.2.3.1 | Validation | 2/17/2023 | Flashing test program onto PCB board configuring all header pins as GPIOs and verifying results to test and ensure sufficient operating condition of all header pins | Complete |
| 3.2.3.5 | Integration | 2/27/2023 | Test manual control operation via website by sweeping joystick element across different ranges corresponding to 0 to 100 % duty cycle, four quadrants corresponding to the different motors and clockwise and counterclockwise orientations | Complete |
| 3.2.1.1 | Validation | 2/27/2023 | Confirm proper accelerometer for the following orientations (pcb top facing): up, down, left, right and perform 2-d incinometer sweep from 90 degrees to 0 degrees over the course of approximatel 6 seconds. Perform python plot analysis to calculate the inclination angle and ensure values in operating range [0, 90 degrees] | Complete |
| 3.2.1.1 | Validation | 3/1/2023 | Confirm proper magnetometer for the 360 degree rotation of the sensor by cross correlating with magnetometer digital compass. Additionally perform temperature collection with on chip magnetometer temperature sensor and confirm valid operating ambient temperature by cross correlating with cellphone therometer application. | In-progress |
| 3.2.2.3, 3.2.2.4 | Integration | 3/9/2023 | Interfacing sensors and motor driver with esp32 header pins and confirming valid operating input voltages across the magnetometer, accelerometer, and L2987n motor driver. The input to the motor driver should read 12 V. The input power pins to the I2C sensors should read 3.3 V. The regulated voltage across the motor Terminals should exist in the range from [0, 12V] | In-progress |
| 3.2.3.2 | Integratoin | 3/20/2023 | Validation of current drawn from PCB to motor driver at [0.5, 1, 1.5, 2.0, 2.5, (and 2.99)] Amps using the ELoad to verify the correct power consumption constraints and limitations of the system. The trace widths are constrained to withstand approximately 3.2A and the current splits from the motors, where each motor receives a maximum of 1A. | Complete |
| 3.2.2.5 | Integration | 3/20/2023 | Testing computation of azimuth and elevation angle at 10 minute time intervals to determine where the system will be pointed to (read-in angles will be compared to a suns position calculator website) | Complete |
| 3.2.1.1 | Integration | 4/10/2023 | Verify motors to move fresnel lens fixed distance every 10 minutes accroding to current azimuth and elevation angle and posts all 9 datapoints for both magnetometer and accelerometer sensors | In-progress |
| 3.2.1.2, 3.2.2.5 | Integration | 4/10/2023 | Full program data collection and posting magnetometer/accelerometer (x,y,z) and temperature data to MySQL AWS Database Web Server | In-progress |

# Q&A

Thank you for listening to the Heliostat Control Tracking Presentation