

EE 4910 WEEKLY REPORT: 3

3/3/2026 – 3/10/2026

Group number: 06

Project title: Developing a Cost Effective NIR VIS Spectrometer

Client &/Advisor: Avishek Das & Manojit Pramanik

Team Members/Role: Ryan Majstorovic, Evan Tamer, Dawson Posekany, Samar Gill

Weekly Summary

Over the past two weeks, the team finalized the initial optical design direction for our 400-1000 nm spectrometer and continued pushing hardware progress forward while waiting on outstanding orders.

On the optics side, we selected an AR-coated 1-inch lens (LA1134-AB-ML) to improve light throughput by minimizing reflection losses, and chose a 25 mm reflective grating with 600 grooves/mm (GR25-0605) for dispersion, offering a practical balance between dispersion and efficiency for broadband, unpolarized sources. We discussed the tradeoffs between transmission and reflective grating layouts and confirmed that post-mounted hardware will be used throughout to simplify breadboard alignment. Rather than purchasing a precision slit assembly at this stage, the team decided to prototype aperture control using existing translation and adjustment hardware available in the lab. We also reviewed concave mirror options and will proceed with standard circular mirrors for initial testing, revisiting packaging once the layout is locked in. As a sanity check, we ran a simple diffraction demo and observed multiple orders, confirming that dispersion is visible and that first-order alignment will be our practical target going forward.

The ETG order for the lens and grating was approved by Professor Manojit Pramanik. The team picked up the original Digi-Key order but found an issue with the digital inverter package type. A corrected order was placed and is currently in transit, along with the optics hardware.

On the firmware side, the team was unable to meet in person this past Monday due to unforeseen circumstances, but continued making progress remotely. The primary software milestone for the week was completed: a testable version of the STM32 code is now ready, along with ongoing work on the design document, presentation slides, and weekly reports. The team plans to meet in person this week to test the firmware on hardware in lab and begin integrating the optics and embedded systems work in parallel.

Past week accomplishments

Samar: Was able to get an initial version of the code for the microcontroller working. Wrote, built, and flashed the firmware to the microcontroller. Some libraries weren't needed for the purpose for his project and those changes are handled in the code.

Evan: Began researching and finding the components for a calibration device. Laser diodes at four different wavelengths were selected, which will allow for more accurate calibration. These diodes will be aligned,

and 50/50 mirrors, which can be fabricated at the ASC, will be used to allow the lasers to overlap at one point. This will mitigate any changes due to the direction of the light.

Ryan: Ran simulations on the optics components we had selected and discovered an issue with 2nd order reflections which will lead to reduced if not completely lost signals from the 800-1000nm range. There are a few options to remedy this.

- 1). Have two operation modes from 400-750 nm and a second operation mode with 600-1000nm (relatively cheap ~\$200)
- 2). Use a linearly varying edge pass filter. (Very Expensive ~\$1600)
- 3). Adjust our wavelength ranges to be only in the 600-1000nm range (Cheapest only one additional optics components is needed ~\$60)

Dawson: I reviewed our current PCB driver board layout, searching for possible inefficiencies that we could improve upon in our next design. A few of the ideas that the board could implement in the future are:

1. A separate analog and digital ground plane. While the use of vias around our power and signal pins isolate these signals from other more sensitive devices on the top plane, tiny fluctuations in the ground plane can occur due to the digital clock signals. Two separate ground planes with a star ground connection is ideal.
2. An op amp as replacement for our CCD signal conditioning. While under ideal conditions, the BJT operates perfectly linearly in the forward active region, the device is known for temperature dependence and wide ranges for some of its specifications. This can make the device hard to plan around. Since we are going for high data resolution, going with an op amp for this use might be a good choice. The team could search for one that offer low noise and low output impedance so that it works better with the ADC inputs of the MCU.

Pending issues

1. The microcontrollers haven't come in quite as quick as we'd hoped from ETG. This made us pivot what we did during our weekly meeting/work session. It turned out to be fine because we accidentally ordered through hole inverters instead of surface mount, so the circuits wouldn't be ready to put together anyway, but we want our microcontrollers so we can start testing.

Individual contributions

<u>NAME</u>	<u>Individual Contributions</u> <i>(Quick list of contributions. This should be short.)</i>	<u>Hours this week</u>	<u>HOURS cumulative</u>
Ryan Majstorovic	Lens and grating ordering. Tested timer setups for CubeIDE. Order monitoring from ETG. Ran simulations for the optics and discovered	5	25

	a major issue with 2 nd order reflections in our upper range of the spectrometer.		
Dawson Posekany	Reviewed PCB design and looked for optimizations.	4	23
Samar Gill	Continued setup of the CubeMX software and early testing of the serial monitor.	4	21
Evan Tamer	Researched and selected parts for a calibration device	4	22

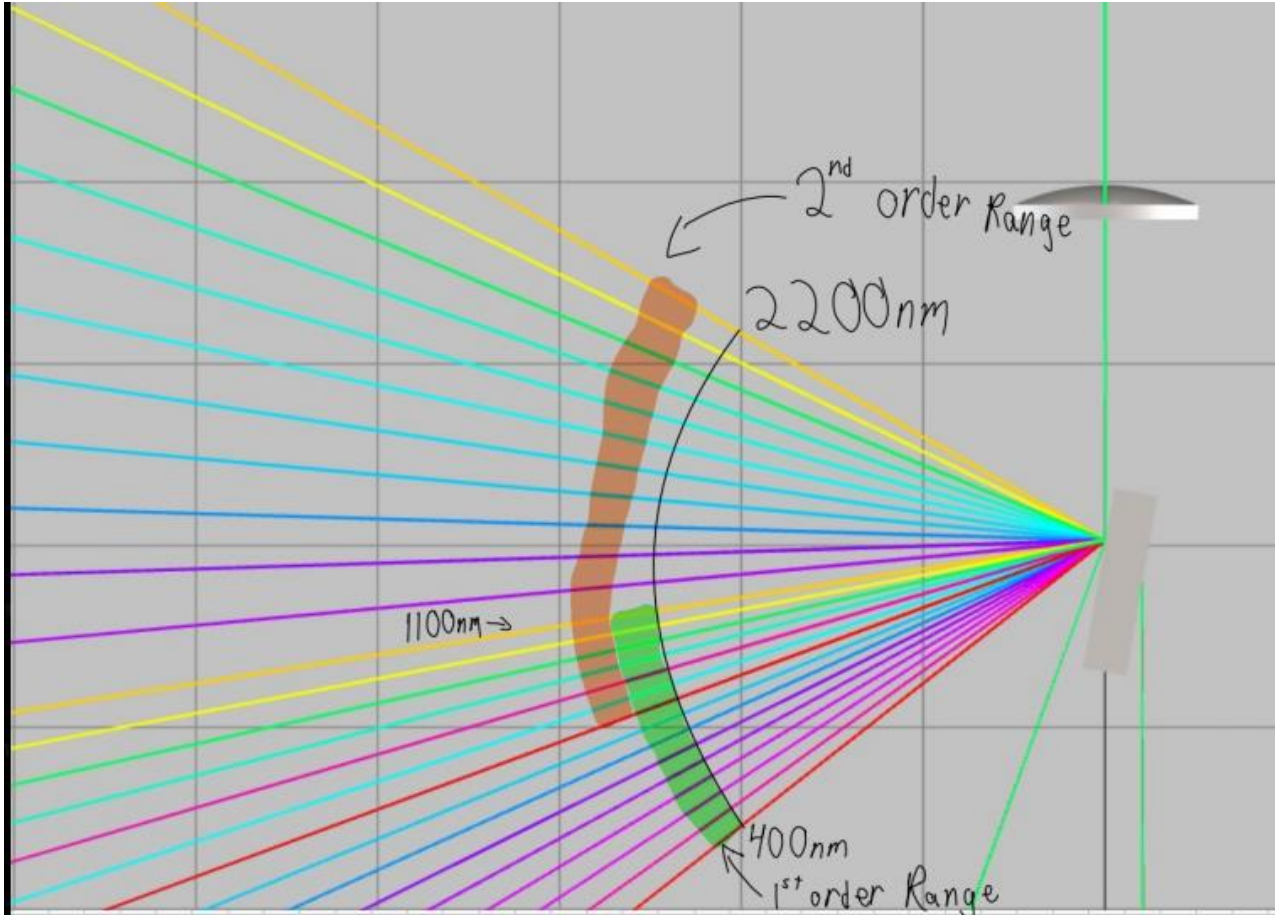
Comments and extended discussion

Plans for the upcoming week

Samar & Evan: Start integrating the CCD with the microcontroller and stream the data to our computer through USB connection. Verify that the sensor is working correctly before beginning optimization steps. Evan will also discuss the details of the calibration device so that parts can be ordered.

Dawson: Catch up with Ryan's timer setup. Look into how our next version of the driver board can implement the changes I suggest in this document and well as how we can add in our external power supply.

Appendix:



Spectral Response

