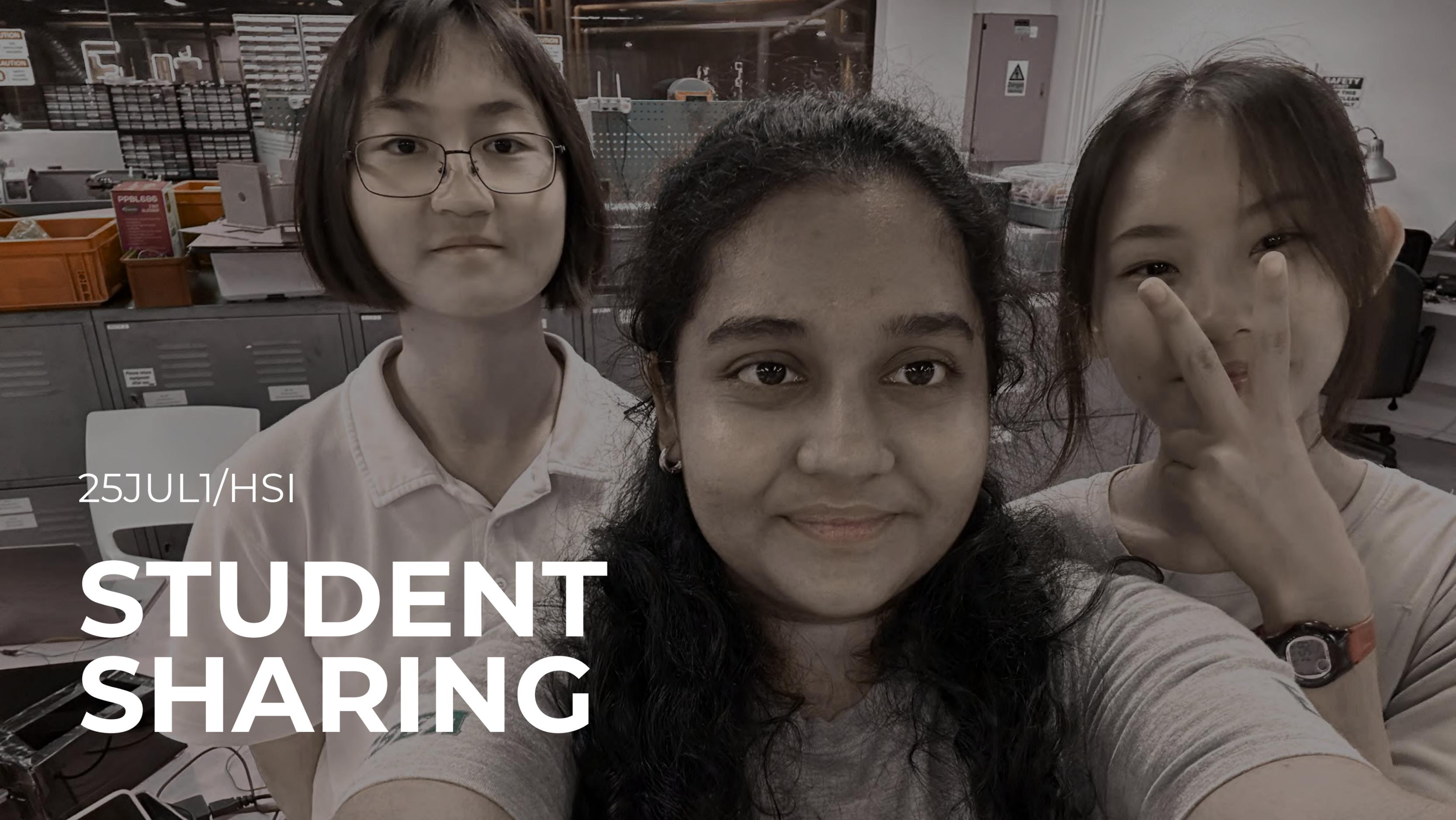25JUL1/HSI

STUDENT SHARING

ACCOMPLISHED DURING SWAP

Tasks and Projects: Interpretation of data

Using OpenCV to obtain pixel values for dispersed light from existing spectrometer, along with Numpy to manipulate data
- Began with cropping out the brightest slit of light (1st order)
- Created graphs of RGB intensity vs. pixel position
- Finally a 3D graph of RGB intensity vs. pixel position vs. frames

Technical skills:
- Reading and manipulating image data (pixel coordinates)
- Accessing and manipulating pixel arrays
- Applying computational tools in a science project context
- Prompt engineering
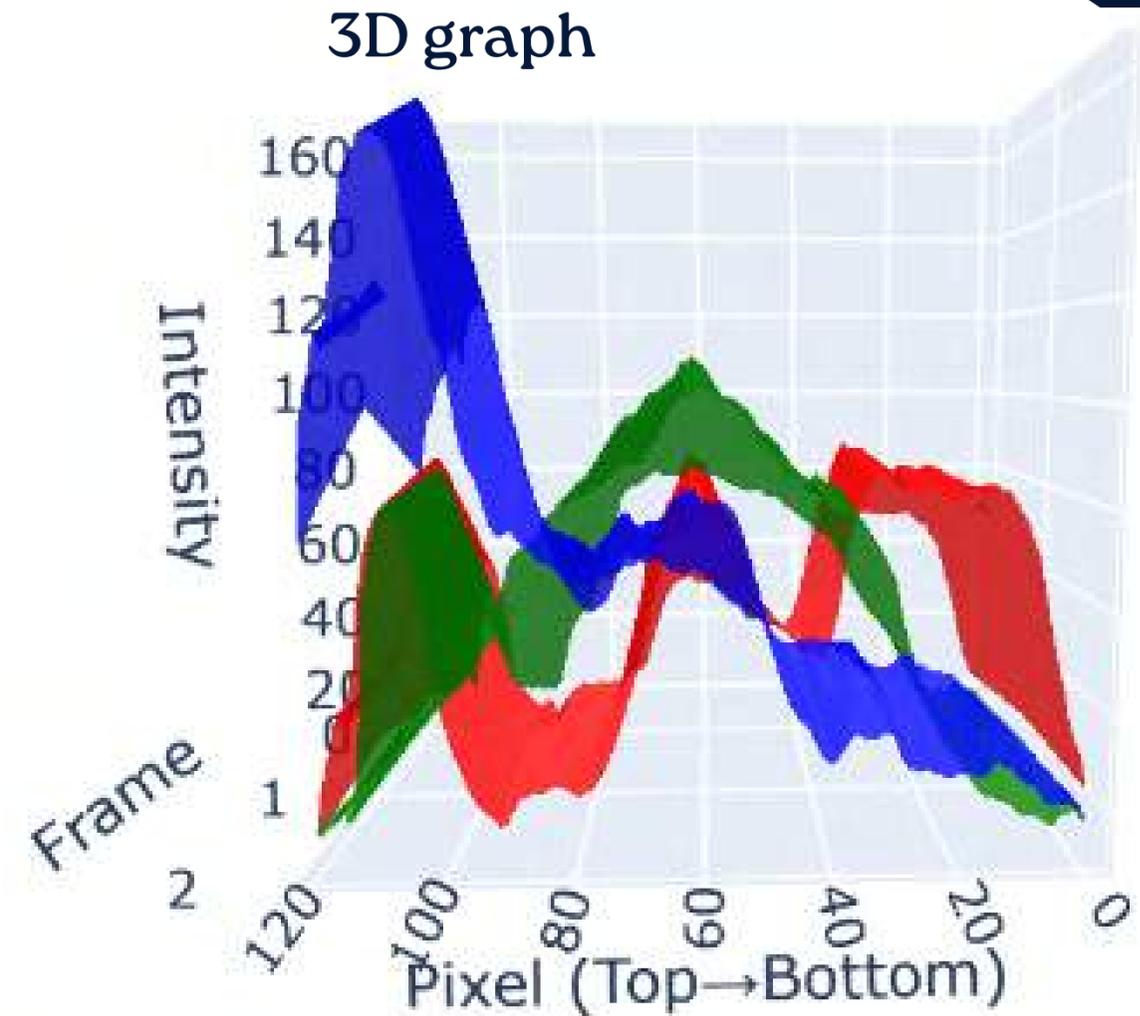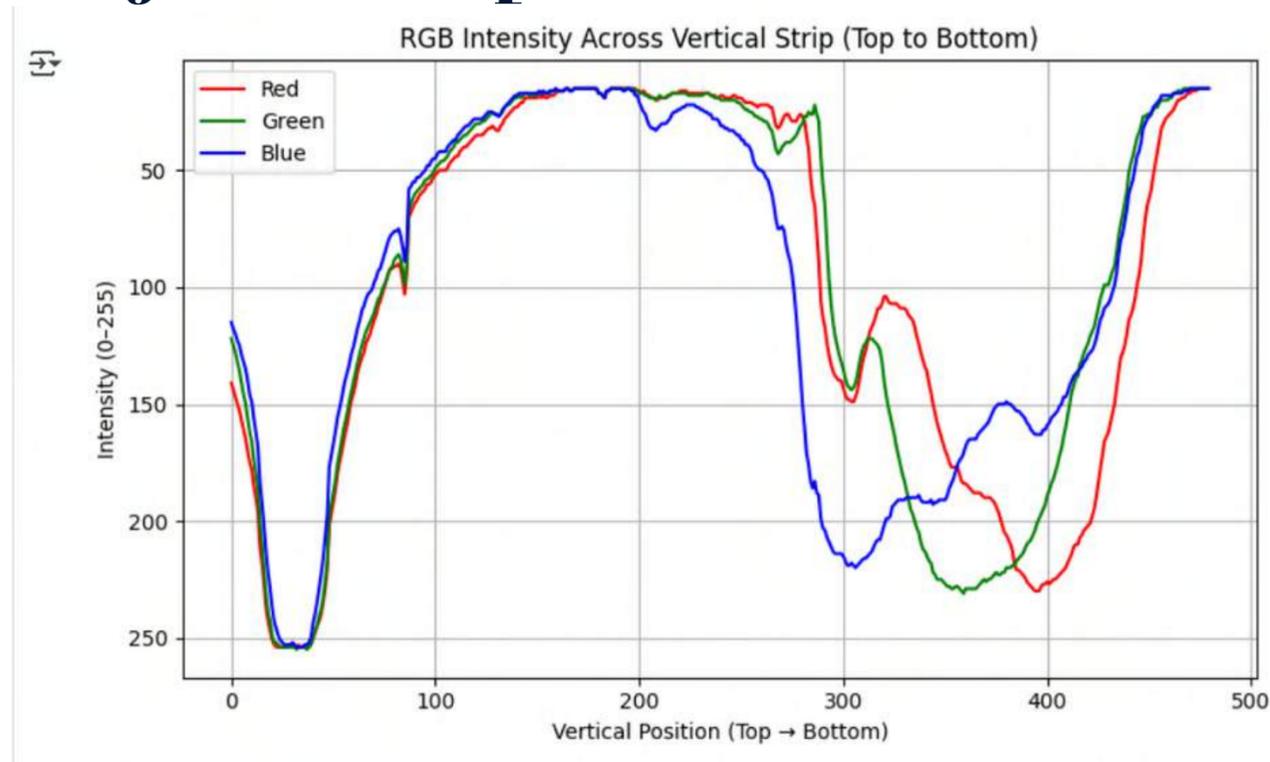
ACCOMPLISHED DURING SWAP

Our Progress
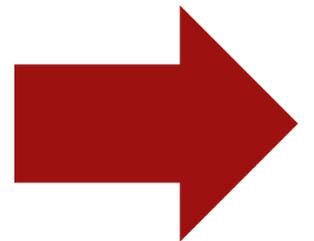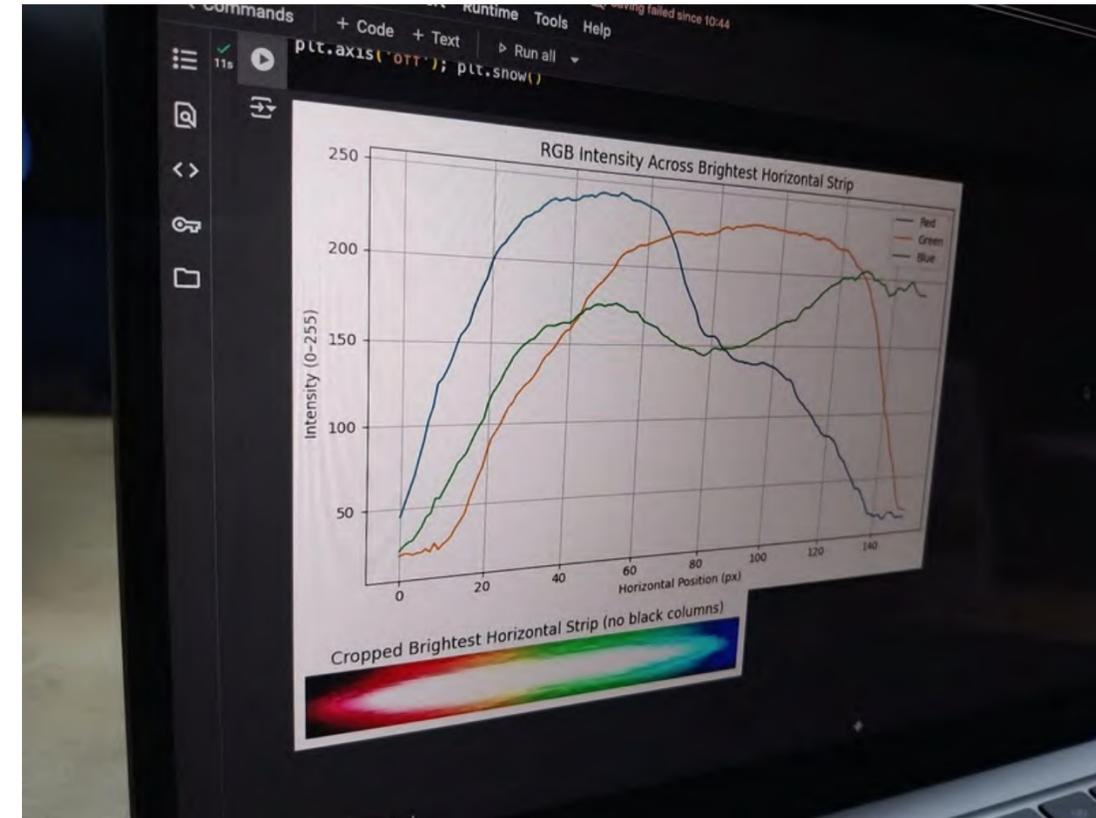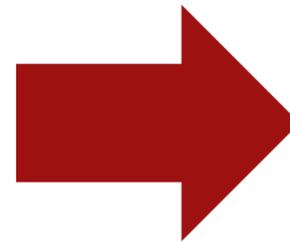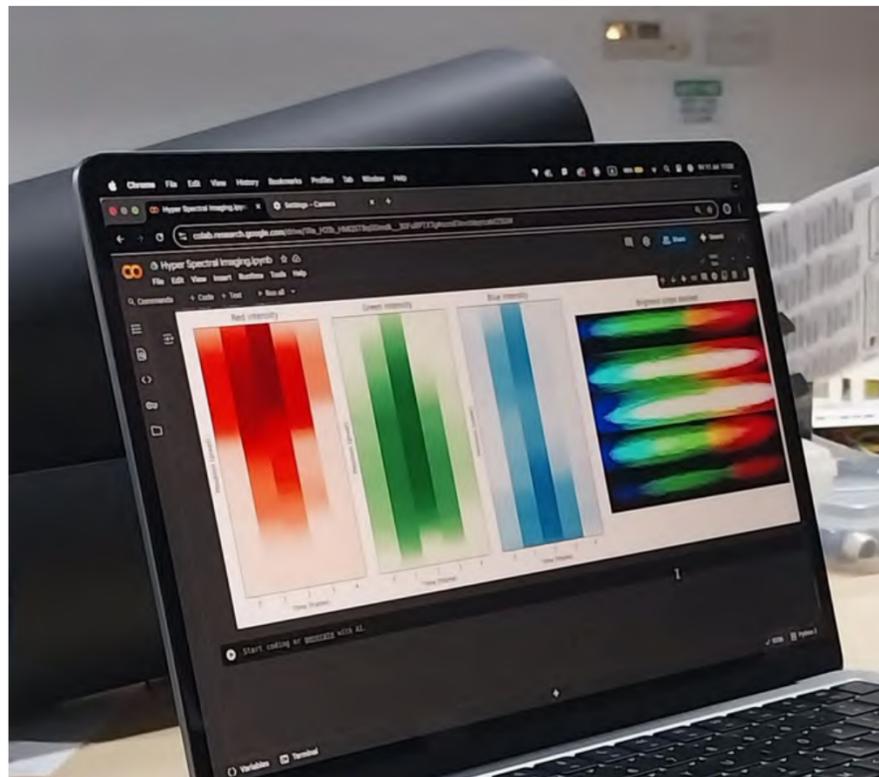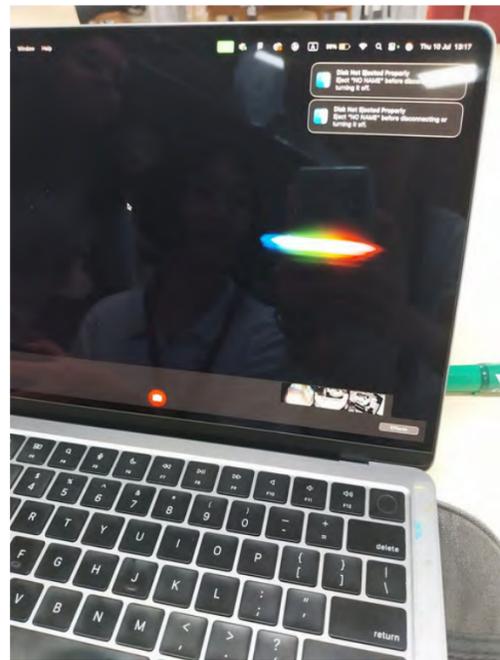
- cropping out coloured parts
- analysing intensity of RGB values

- forming a graph based on gathered information

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Tasks and Projects: Interpretation of data

RGB Intensity Across Vertical Strip (Top to Bottom)

Cropped images

Vertical Strip Frame 1

Vertical Strip Frame 2

Vertical Strip Frame 3

3D graph

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Tasks and Projects: Designing the spectrometer

Designing a spectrometer to better capture 1st order maximum of light:
- We wanted to design a spectrometer so that the USB camera only captures one of the 1st order maximum and avoid the 0th order completely to reduce unnecessary brightness/distractions for the code.

Technical skills:
- Applying understanding of multi-slit diffraction angles for lights of different wavelengths to calculate range of angles for 1st maxima for VL spectrum
- Using concepts learnt in classrooms (eg trigonometry to calculate dimensions)

Improving design to enhance structural integrity:
- Incorporating calculated angle values to reduce no. of components of spectrometer: 3 → 2 by including the grating inside the tunnel itself and designing the camera to be at an angle to capture the range of frequencies
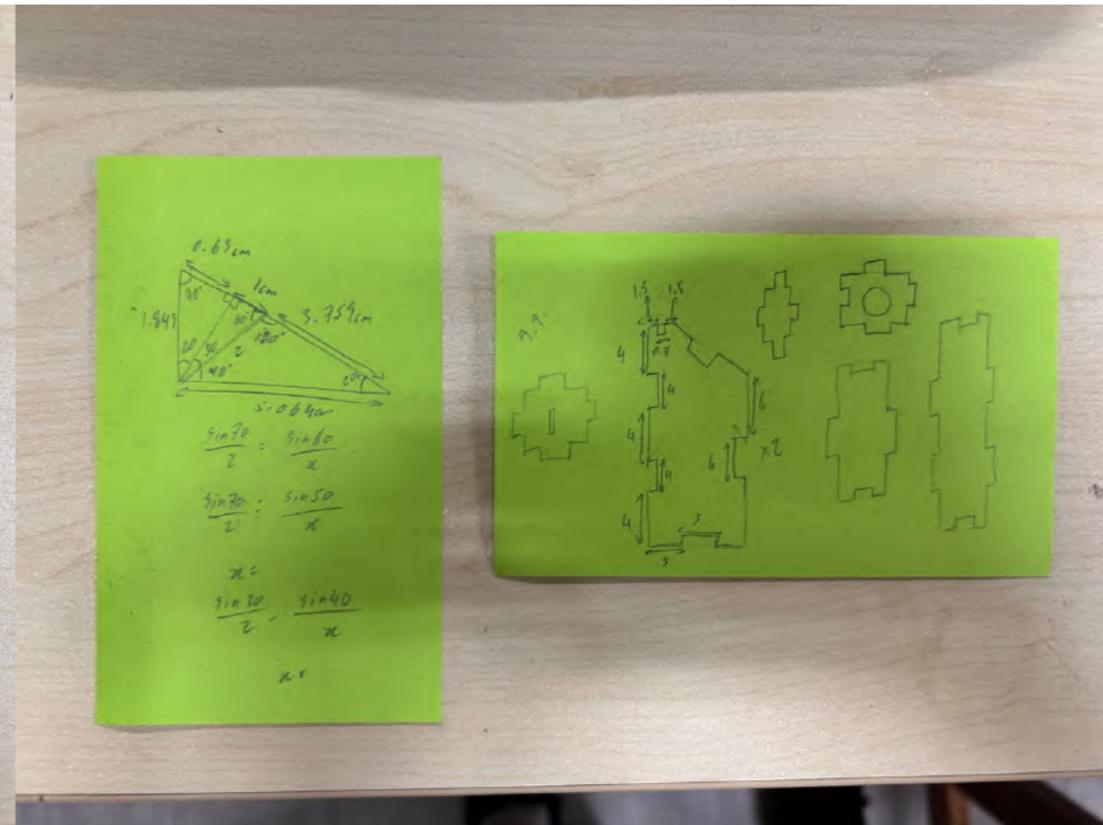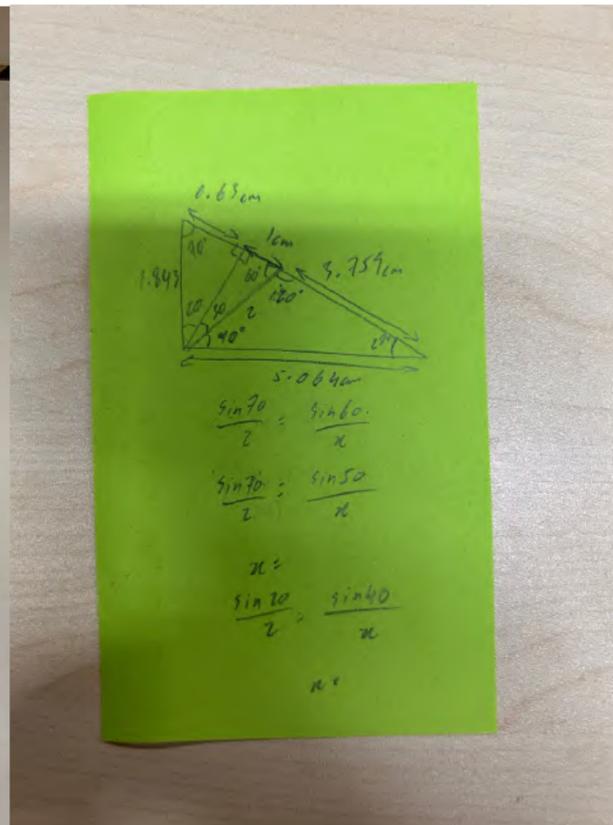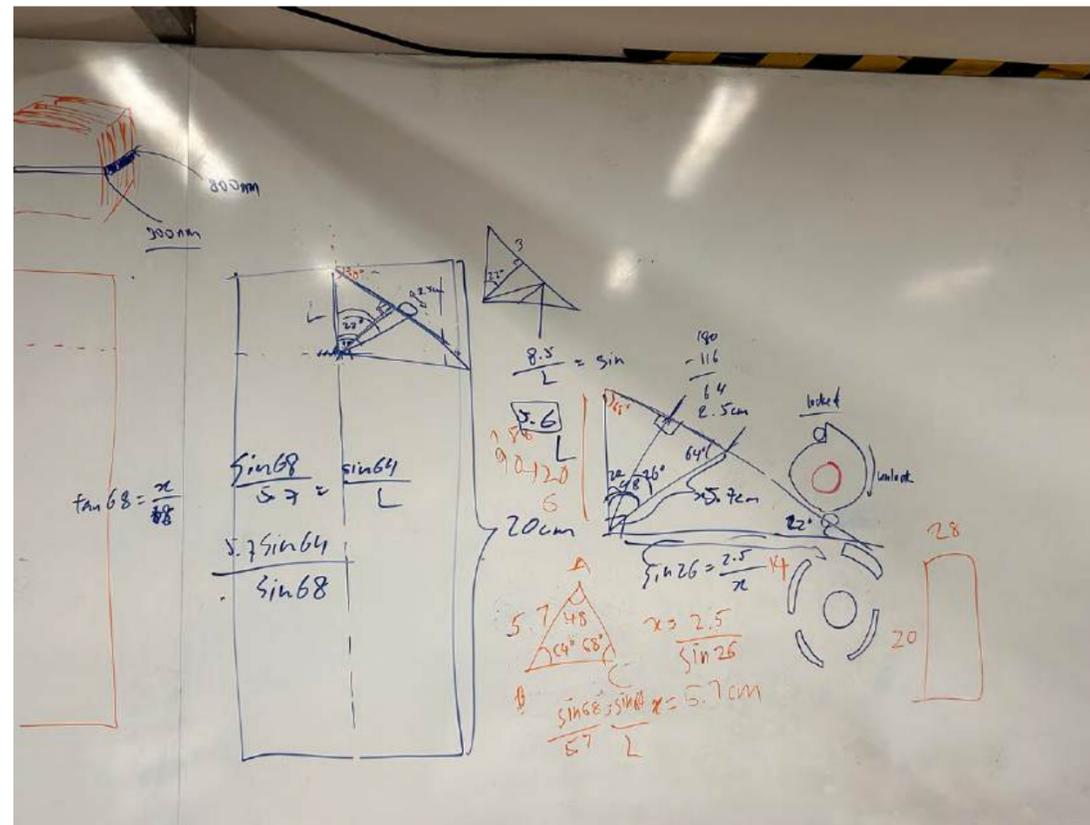
Technical skills:
- Using Onshape to design pieces of the spectrometer
- Learning about laser cutting & operating Universal Laser Cutting System

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Tasks and Projects: Designing the spectrometer

Some calculations...

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Tasks and Projects: Designing the spectrometer

Onshape action...

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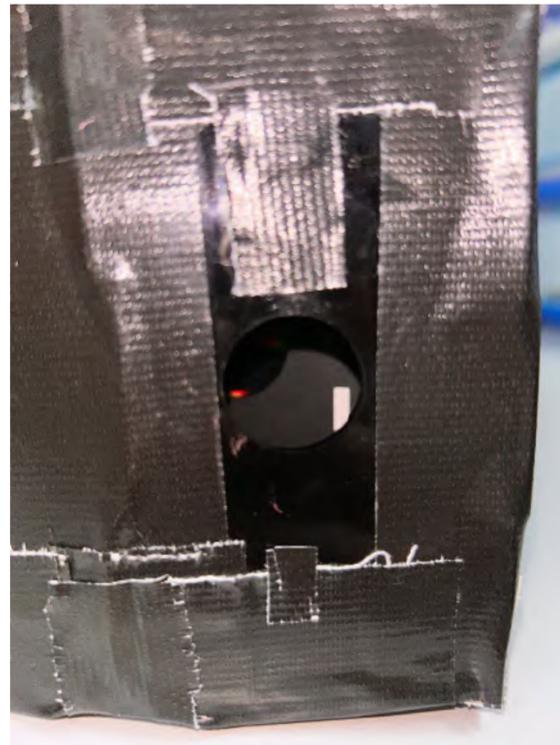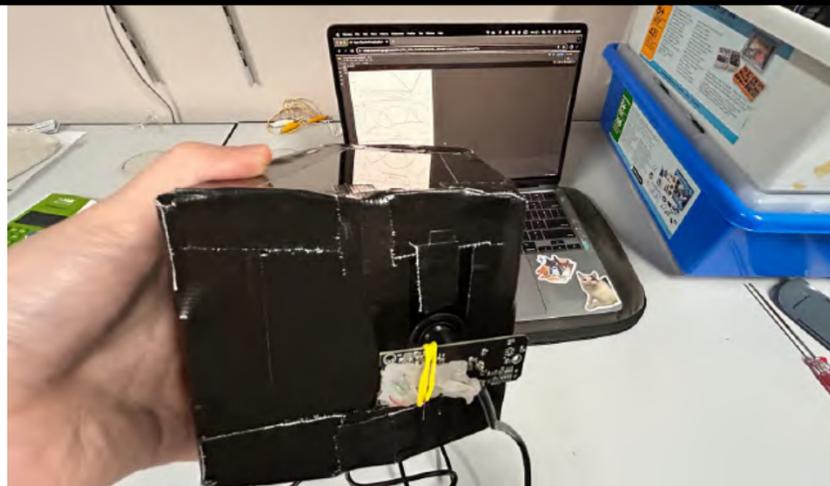**Tasks and Projects: Designing the spectrometer**

Laser cutting...

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Tasks and Projects: Designing the spectrometer - prototyping

Initially had 2 prototypes and tested which one worked better...
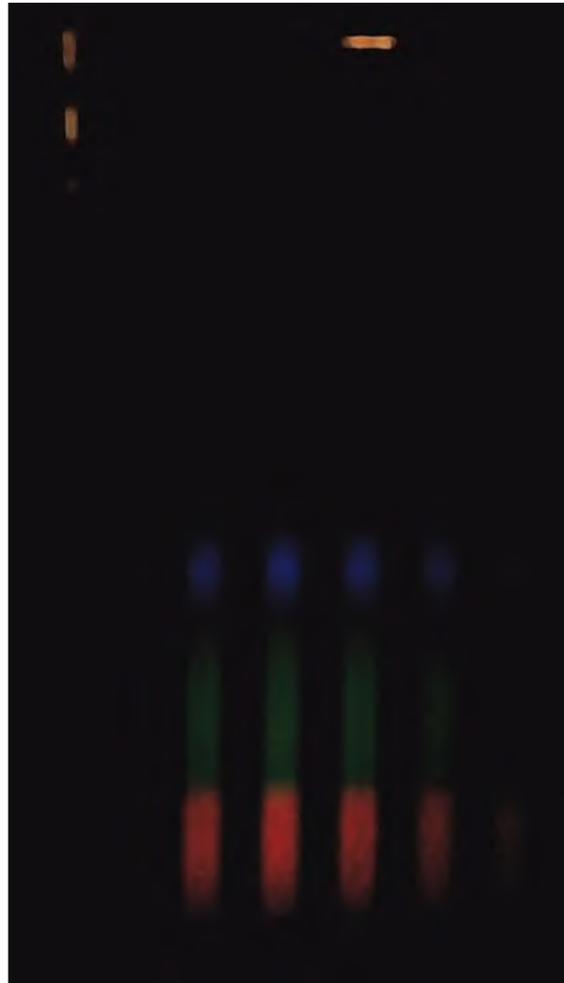
Prototype 1:
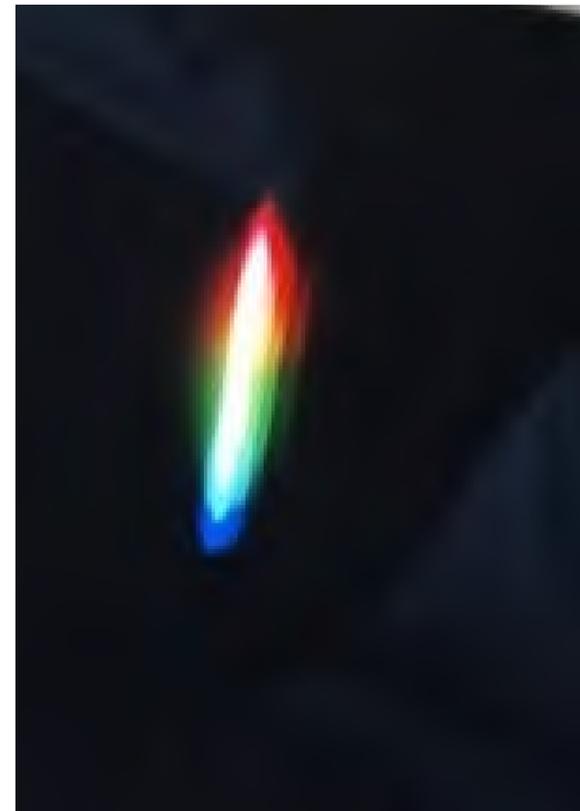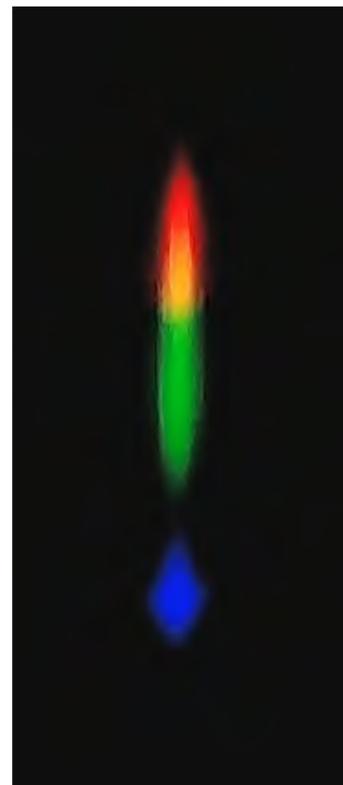
Prototype 2:

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Tasks and Projects: Designing the spectrometer - improvements made

Old design

Our final design

Improvements:

- **Less stray light**
- **Brighter, easier to see**
- **Only captures 1st order, excludes light from 0th order**

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Tasks and Projects: Arduino - Hardware & Software

```
// Define motor control pins
int motorPin1 = 8; // Connect to IN1 on L298N
int motorPin2 = 9; // Connect to IN2 on L298N

void setup() {
  // Set motor control pins as OUTPUT
  pinMode(motorPin1, OUTPUT);
  pinMode(motorPin2, OUTPUT);
}

void loop() {
  // Move the motor forward
  digitalWrite(motorPin1, HIGH);  // IN1 to HIGH
  digitalWrite(motorPin2, LOW);   // IN2 to LOW
  delay(2000); // Run motor forward for 2 seconds
```
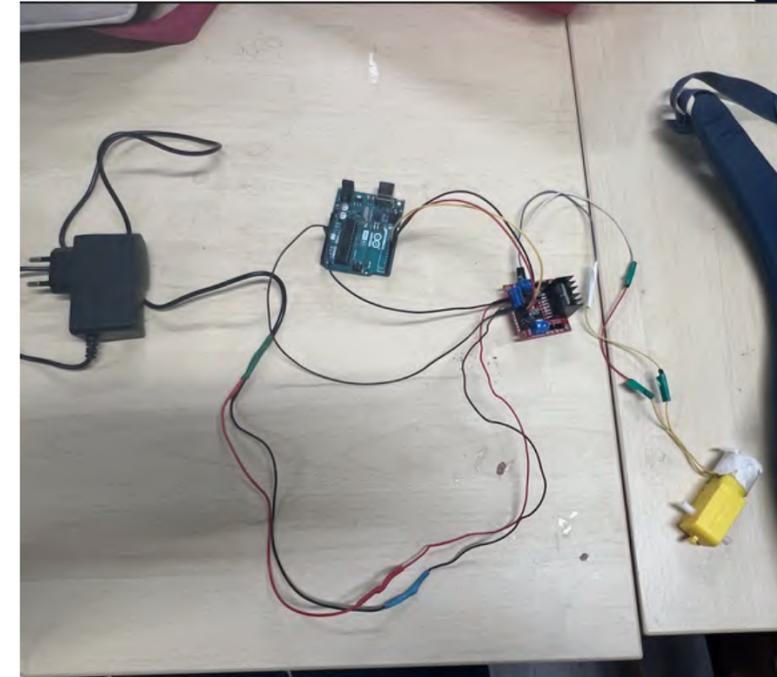


```
    servo.write((0);    // rotate slowly servo to 0 degrees immediately
}

void loop() {
  for (int angle = 0; angle <= 180; angle += 10) {  // rotate slowly from 0 degrees to 180 degrees,
    // in steps of 1 degree
    servo.write(angle);  // control servo to go to position in variable 'angle'
    delay(10);           // waits 10ms for the servo to reach the position
  }

  for (int angle = 180; angle >= 0; angle -= 10) {  // rotate from 180 degrees to 0 degrees, one by
    servo.write(angle);                             // control servo to go to position in variable 'angle
    delay(10);                                      // waits 10ms for the servo to reach the position
  }
}
```

WHAT WE HAVE LEARNT

- Design and calculate precise dimensions of a spectrometer to ensure it fulfils its purpose applying physics and maths knowledge
- Improved our problem solving skills through trial and error
- Combine hardware and software to achieve a real-world outcome
- Polished prompt engineering skills
- Operate a laser cutter using softwares such as Onshape, CorelDraw to import, and Universal laser system
- Practiced communication & other interpersonal skills by working together on this project as a team

THANK YOU