CubeSat Final Presentation

GonkBots - Algonquin Regional High School

Team Members

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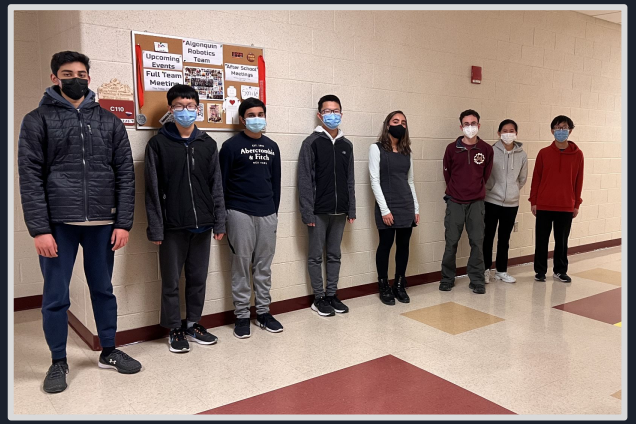
Fred Probst - Junior

Stef Linden - Senior

Dan Strickland - Mentor



Our CubeSat

Our Mission

- To identify colored pieces of plastic in an ocean from a birds-eye view

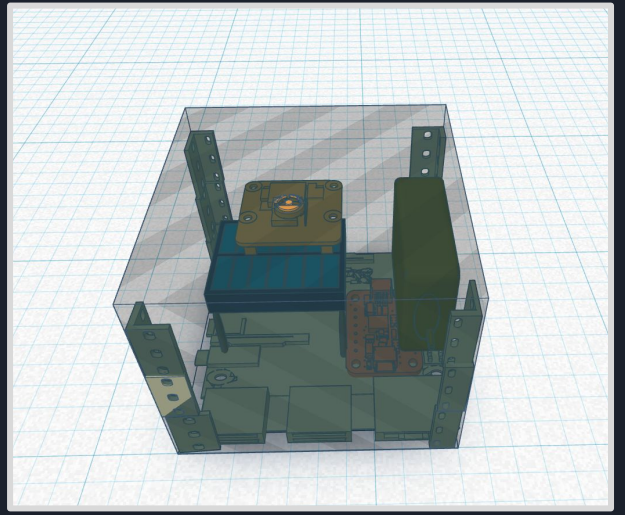
How Our CubeSat Accomplishes This

- Takes pictures using a Raspberry Pi Camera
- Communicates with the ground station
- Processes the images to identify the colored plastics

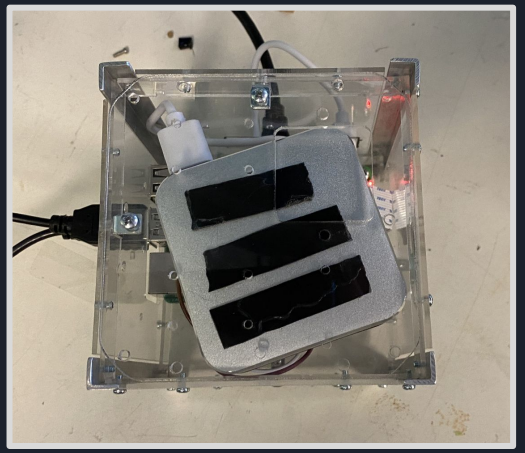
Our CubeSat

Hardware Components

- Raspberry Pi
- Raspberry Pi Power Supply
- Micro SD Card
- Raspberry PI Camera
- IMU
- Battery
- Acrylic Panels
- Acrylic Side Brackets
- Aluminum Corner Rails
- 4-40 L Bracket
- F-F Jumper Wires



Our CubeSat

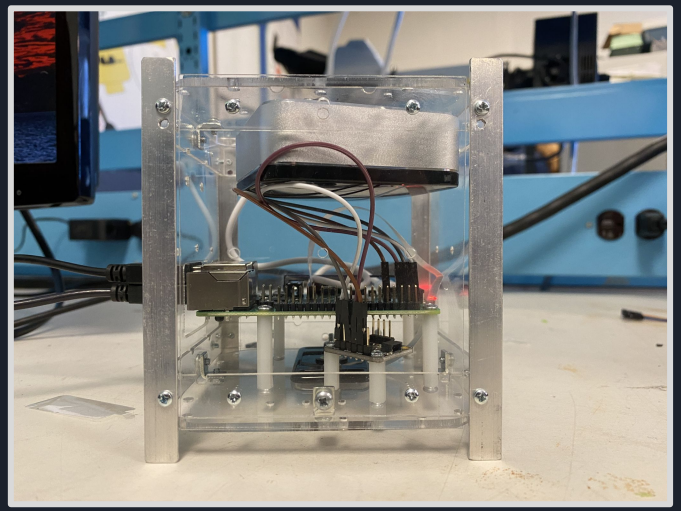


Key Features

- 10,000 mAh Battery
- RaspberryPi
- 1U

Key Processes

- Recognize colored plastics using imaging and software processing
- Transmit processed images to ground station

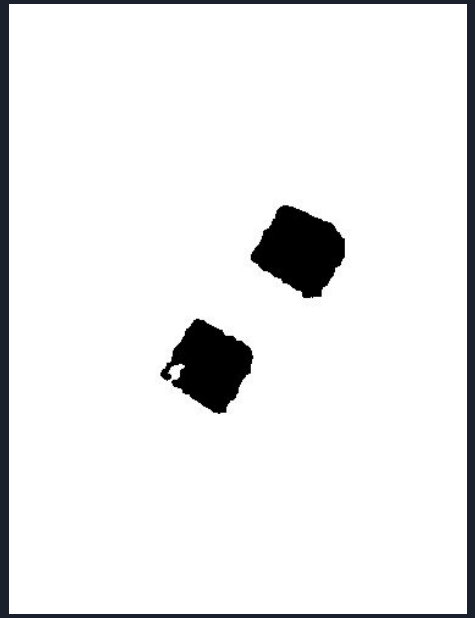


Key Systems

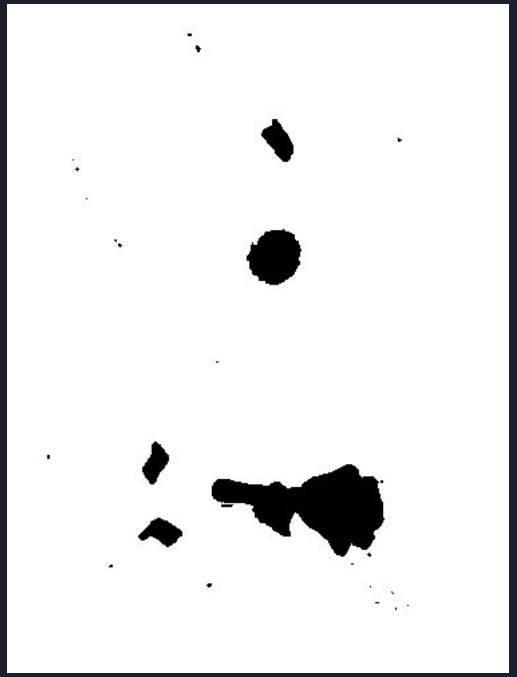
- Power System
- Communications System
- Software
- Hardware

Tech Demo Video

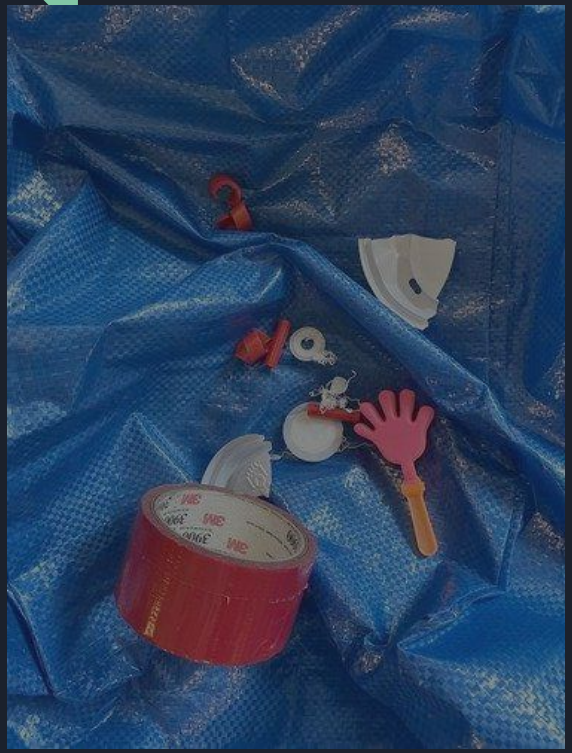
Final Testing Results (1)



Final Testing Results (2)



Final Testing Results (3)



Final Testing Results (4)

Final Testing Results (5)

Possible sources of error:

- Sometimes detects blue as plastic
- Edges are not well defined
- Lost data between CubeSat and ground station
- Plastics out of visible region of the camera

Scaling to a Flight Spacecraft

Upgrade materials

- Use aluminum or titanium
- More durable/lightweight shell to resist space forces
- More airtight hardware
- Improve and increase power supply and solar panel strength to get more solar power
- Use infrared/radar systems to complement the camera system
- More powerful, high-resolution camera system

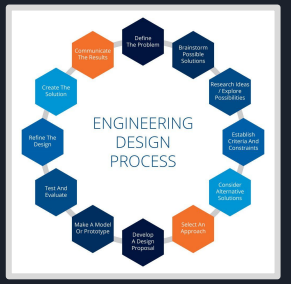
Scaling to a Flight Spacecraft

Improve software

- Improve accuracy of color detection
- Improve accuracy of detecting plastic patterns in ocean by using AI
- Increase range of detection since bluetooth is only used for close quarters
- Gather data on the amount and type of trash detected
- Differentiate two different plastic objects right next to each other
- Add more accurate detection for white-colored plastics

```
class PlasticLocator:

    def __init__(self, file_name):
        self.file_name = file_name
        self.hue_range = range(180, 270) #hsv range for blue

        #file number
        f = open("number.txt", 'r')
        self.file_num = int(f.readline().strip())
        f.close()
        f = open("number.txt", 'w')
        f.write(str(self.file_num + 1))
        f.close()

    def __str__(self):
        return (f"{self.file_name} Plastic Locater")

    def unflatten(self, input, width, height):
        output = []
        for i in range(height):
            temp = []
```

Lessons Learned



Planning

It is important to plan a layout for the mechanical and software components of a machine due to many requirements. Once blueprints and outlines are made, the team can easily divide and conquer the tasks.

Satellite links

It is important to consider how fast and how accurate will data be transferred from the satellite to the ground antenna. Through Shannon-Hartley theorem and other calculations we were able to find out how much data was lost in between the satellite and ground link.

Lessons Learned (Power)

Satellite Power

It is essential to be aware of the satellite's power usage. If the stored power is used at a greater rate than the solar panels can charge, it can hinder the abilities and efficiency of the satellite over time.

Total Power = Raspberry Pi + IMU/Camera (2.29W + 0.195W = 2.485W)

Power Producers: Faulty solar panel (2.3V, 0.00138W, 0.6mA), solar panel (6V, 0.6W, .1A), battery (10,000mAh)

Factors that determine effective power consumption:

- Code time complexity
- Data transmission

Thank You