***Environmental Sensor Project***

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# **Goal**

Programming an environmental sensor to calculate NDVI which will help to identify whether or not plant contains live green vegetation that has chloroplasts which have the pigment chlorophyll which absorbs deep-blue and red light, so that the rest of the sunlight spectrum is being reflected, causing the plant to look

green

# **What is NDVI**

**NDVI: Normalized Difference Vegetation Index**

* Help to identify whether or not plant contains live green vegetation
* Provide measure of health and vitality

**Healthy and/or dense vegetation:**

* Reflects a lot of NIR (Near Infrared Lights)
* Low red reflectance

**Not Healthy or sparse vegetation:**

* Less NIR
* More red reflectance

**Formula:**

* Healthy vegetation **HIGH** NDVI
* Less healthy vegetation **LOW** NDVI

|  |
| --- |
| **NDVI Value Indication** |
| < 0 Inanimate / dead material, e.g. roads, buildings, soil or dead plants  0 → 0.33 Unhealthy plant material  0.33 → 0.66 Healthy plant material  => 0.66 Very healthy plant material |

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# **Materials needed for project**

*(please add other materials that we use throughout the project)*

* Raspberry Pi B+
* Micro SD card
* Pi Noir Camera

**Raspberry Pi Noir camera - replacing IR block filter with red or blue filter:**

“It is also possible to capture all the information needed to compute NDVI in just one camera. If the standard IR block filter is replaced with a filter that passes NIR and blocks only red light, then the red channel will record mostly NIR light. The blue channel which will record mostly blue light (some NIR light will also be captured in each channel) can be used to represent wavelengths that are absorbed by [plants.”](https://publiclab.org/wiki/ndvi-plots-ir-kit)

<https://publiclab.org/wiki/near-infrared-camera>

<https://publiclab.org/wiki/python-webcam-codes>

# **Schedule**

## Week 1*(June 24th - June 28th)*:

* Research on how to use Raspberry Pi to create an environmental sensor. What kind of camera do we need to use and how is the NDVI equation implemented?
* Buy materials by the end of the week.

## Week 2*(July 1st - July 5th)*:

* Set up raspberry pi and camera (Sean)
* Write code that allows camera to turn on and take photo
* Start working on NDVI calculation
* Set up github

## Week 3*(July 8th - July 12th)*:

* Coding + Manufacturing:
* Set up VNC (Virtual Network Connection)
  + Allows us to view raspberry pi contents without being connected to desktop
  + IP address: 172.20.10.4:1
* Create and work on code that will allow us to take pictures and process NDVI data
  + Camera/Photo Code (Completed)
  + Color Band Separation (Completed)
  + NDVI Calculation (Completed but needs to be verified)
* Design Raspberry Pi Cover + Camera Mount
  + Perform Initial Drawing
  + CAD Model
  + Reach out to Tara about 3D Printing
  + Talk to Duha about physical requirements of cube sat and the conditions of the space launch. What are the physical requirements of the sensor? How is it going to be positioned? etc

## Week 4*(July 15th - July 19th)*:

* Early phases of testing - just to make sure we are on the right track.
  + Do camera images of green grass vs. brown grass give us reasonable results?
  + Show our results to one mentor/professor to make sure the sensor is working correctly?

## Week 5*(July 22nd - July 26th)*:

* Testing
* How are we testing this?:
  + - Will need to look at different types of plants, each at different stages of health. This will help us gain a sense of how accurate our sensor is.
      * Can our sensor pickup on the difference between a healthy plant, a somewhat healthy plant, a dry plant, and a dead plant?
* Do I need to contact any facilities on campus (greenhouse, farm, nursery)
  + Who to contact and when should we contact them by? Week 4?
  + Need to talk to someone who takes care of the plants and knows which stages of health the plants are at.
* Use data from testing to improve code and fix any errors in NDVI calculations.

## Week 6*(July 29th - August 2nd)*:

* Continue to improve code/debugging
* Second round of testing to make sure that we are getting more accurate results.
* 3D print cover/camera mount

## Week 7*(August 2nd - August 9th)*:

* What can we do to make sure our product is the best it can be?
* How are we going to show the results on the screen?

## Week 8(*August 12th - August 17th)*:

* Prepare presentation
  + Presentation should include a description of the project and what we did to achieve the desired outcome.
  + Pitch is geared more towards helping SSS club get money rather than turning this idea into a business.
  + Make the powerpoint/poster presentation for demo day
  + Are we going to test our product with live plants? Take a picture of plants and test the results in front of the investors?

## Week 9(*August 19th - August 21st)* :

Practice presentation:

Who is saying what

## Week 10 (August 21st):

* Demo Day!

# **Meeting Reports**

# **Meeting July 8th**

* Finish up coding by the end of this week (August 14th)
* Gather data for testing
  + Visit farms/vegetation areas to take photos
  + Contact farmers and figure out how to get access to vegetation
* For next week
  + More hours
  + Figure out schedule
  + Make plans for gathering data and testing
  + Where will the camera be positioned?
  + Physical constraints
  + Temperatures and physical constraints of the satellite?
* How do we want the product look like in 5 years?

## **Meeting July 10th**

* Testing:
  + HDMI OR USB for the testing
  + toy helicopter to collect the data
  + Use previous research papers to compare the data (more than just one )
  + Testing condition, no clouds or shades on the way
  + need to take a picture of the majority of crops not just one plant after initial testing
  + do not worry about the temperature yet
  + The camera must be very stable so they can use on cube satellite
* Camera:
  + Have camera data sheet
  + Need dimension of camera
  + CAD model base and stand for the camera
* August 1st there is workshop 12:10-1:50 pm at chemistry building 179 work with NDVI and how to measure the crops
* Results:
  + What can be the cause of healthy and unhealthy crops (print the result)
  + If unhealthy how unhealthy or healthy is the plant; give the percentage
  + On presentation how long it takes to snap and process the photo
* Presentation:
  + Make a research poster
  + Make brochure
* Don’t worry about the launching yet