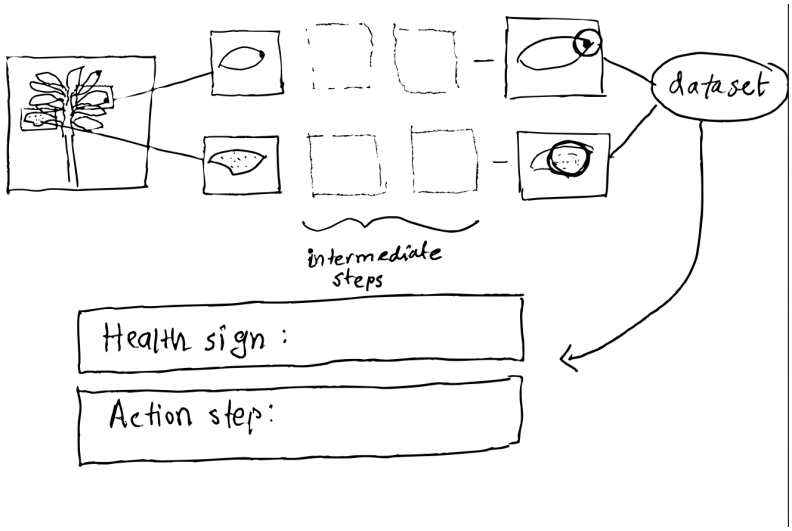
Github Repo: https://github.com/MHC-FA23-CS341CV/computer-vision-final-project-climateteam

Milestone 2

PROJECT NAME	TEAM NAME	GROUP MEMBERS (NAME, EMAIL)
(plant, look, mentor/assistant, care…)	Climate Team	Autumn Nguyen , Julia Diep Ho , Sulagna Saha (Rasha)

PROJECT OVERVIEW

PROJECT DESCRIPTION	1. GOALS: For: - User: know how to take care of their indoor plants - CV technique: detect health status/issues - Developers: learn how to apply CV techniques, how to design a dataset of (plant species, health signs, action steps…) to get from the input (image of the plant) to the output (action steps for the user), maybe how to use ML to detect species. 2. EXPECTED DELIVERABLES: - A prototype where a user uploads the picture of a plant in Google Colab, sees the picture of the plant with the health signs lit up, and reads the output for plant care advice. - A detailed project report documenting the methods, results, and conclusions - A presentation summarizing the project and its findings 3. EVAL METRICS: - CV: how much we utilize the CV techniques we learn in good ways - Impact: how accurate and how helpful is our plant care advice
WORK SHARE	How is the work going to be shared among the group members?
IDENTIFIED CHALLENGES	1. Accumulation of datasets and classification 2. Decision on the output (having a model or a if/else structure?) 3. Leaf

TENTATIVE SOLUTIONS	Flow of project: 
(OPTIONAL) PRELIMINARY RESULTS	

PROJECT COMPONENTS

INTERACTIVE COMPONENT	Users uploading photos and reading results
TECHNIQUES LEARNED IN CLASS	Edge detection, Gaussian blurring Sharpening, Segmentation
BEYOND THE CLASS MATERIALS	Object detection Color thresholding (to know that brown spots are brown, and how brown they are…)

TENTATIVE TIME SCHEDULE

The proposed progress time schedule before the project due date. Please take into consideration the project milestones listed on the course calendar. You are encouraged to specify checkpoint types (W: for writing, C: for code development, and L: for learning new techniques or going over relevant tutorials)

ACTION ITEMS (CHECKPOINTS)	START	FINISH	PERSON (who's in charge)	TYPE (W, C, L)
Researching about the common signs of illness/pests of Swedish Ivy, Spider Plant, Snake plant	Fri Nov 24(morning)	Fri Nov 24(mid-day)	Rasha	L
Learn about object identification for one image of indoor plant			Autumn and Rasha	L
Learn about image segmentation for one image of indoor plant	Fri Nov 24 (after Rasha's 1st action item)	Mon Nov 27	Autumn	L

Learn about color thresholding for one image of indoor plant			Julia	L
(more to be added after finish learning these initial learning action items)				

Initial brainstorming

COMSC 341-CV (Fall 2023)

Group meeting Tue Nov 21:

- Discuss each person's ideas and feedbacks

Minimum level of interactivity: people would be able to actively do something (click, drag, make a choice, take a picture, upload a picture…) to get the idea we want to convey → showcase. We can talk about details of cv and ML in presentation.

Usually the interactive climate AI computer vision projects we saw in museums or on websites are:

Input = User's interaction → fetch data from big data in backend → computer vision/ML/big data processing → data visualization → Output = display of visualization

But for a small 2-week project, maybe we don't have the capacity for the fetching and data visualization parts. So **Input = User's interaction → computer vision → Output = display of the resulting images through computer vision**

Input = user holding the plants in front of webcam, or uploading pictures of plants taken from webcam
CV = detect signs of unhealthiness
Output = based on the detection, tell the user what to do

Some ways to collect dataset:
-> Making our own dataset! From green house or taking indoor plants that we have, we make make a dataset and label them

-> To make our own dataset, we need to list commonly used indoor plants (which can be the categories) and for each categories, there should be an approximate number of pictures of leaves
-> https://paperswithcode.com/paper/plantdoc-a-dataset-for-visual-plant-disease this is another dataset

Learning opportunities:
-> As we will be collecting the dataset and doing the image pre-processing, we will need to understand every step clearly

It's so hard to find pure CV projects on the internet without neural networks, or some kind of machine learning

Pure CV like in class assignments → mostly about techniques, not impact or engagement
If we want impact/engagement, then maybe we have to use ML…?
We want to practice CV techniques but we also want to have some impact.

- Discuss Minimum Viable Product for delivery at demo
- Final plan for the next 2 weeks
- Submit Milestone 2

(Draft Individual Plan): [Should be deleted later](Rasha)

Climate Impact Visualization Tool

What is your interactive project idea? Explain how you envision users to be able to interact with the program you developed.
- Users can select a country and year of their choice.
- After selection, the program fetches satellite images of the chosen country for the specified year, processes them, and displays the results. The output includes visual comparisons showing changes in land use, forest health, and possibly temperature increase
What are 1-3 datasets that could be used to validate the correctness of your program? These will be helpful as you start writing your final project report.
Google Earth Engine Datasets: Offers a comprehensive collection of satellite imagery with historical data, ideal for analyzing changes over time.
Can provide specific data like land cover, forest vegetation indices, and surface temperature.
What computer vision techniques/methods do you plan to use (e.g. image filtering, interest point detection, image transformation, optical flow, neural networks, etc)?
This can be more structured but right now I can think about image classification and color-thresholding for comparing pictures from different areas. Time Series Analysis using neural networks can also help as well.
This tool can be educational to compare which country is facing worse climate impact in recent years.

Location Aware Recycling Assistant:
Users take a picture with the webcam in google colab (that's what Melody shared a reference for in the class), and we pass that image for image classification/object detection in the CNN model. Then (this part can go in many directions) but what I think right now is the output of the model should be a text like "plastic bottle" - we can connect a LLM (GPT-3) for the location based recycling information to fetch the out "is plastic bottle recyclable in South Hadley"/ or a dataset including the info (but this part is complicated….). We also need to record a string of the user's location. I feel like I want to work on a worth-it project but my brain is not braining :>

Autumn's thoughts on:
- Rasha's climate visualization plan:

Likes:
I like the concept of doing computer vision image processing on satellite images!
Beside Google Earth, we can get high temporal and spatial-resolution images from satellites like GOES, LANSAT, SENTINEL…

Concern:
For the interactive part to be allowing users to select a country and a year of choice, our project would need to store and process a very large amount of data. Otherwise, if we want to get raw data from the internet every time the user makes a choice, we will need some function or Machine Learning model that can process the satellite image on the go.

- Julia's plan about processing image of fruits/food for colorblind people:

Likes:
I like the motivation! Has this kind of application been successfully done and used by colorlind people yet?

Concern:
How do we get the correct level of ripeness of each individual fruit? Every species has a different color…
Other than color matching, what computer vision techniques would we use in this application?

- Rasha's recycling plan:

Likes:
Awesome combination of objection detection and LLM for fetching location-based recycling info!

Concern:
People never take a picture of their throw-away items (or trash)… let alone opening their laptop and hold up the trash to take a picture with the WEBCAM…
It's not clear whether there is any use to using CV and ML to figure out stuff's recyclability. On most cups and boxes and containers, there is usually a sign saying if it's recyclable or not, even how to recycle, what's the plastic type, etc. The problem with recycling is that we don't have the recycling facility, or any effective recycling pipeline, to actually recycle the trashes, not that people don't know how their trash should be recycled.

Despite the concerns about the purpose, we can follow that idea just to learn techniques! What we learned may be relevant to using Computer Vision and AI in waste sorting robotics. An article about a start up that does this:
https://www.recycling-magazine.com/2021/04/30/fanuc-partners-with-recycleye-to-automate-recycling-industry/?ref=blog.roboflow.com

Ideas:

- Recognizing animals from wildlife camera → conservation purpose

Likes:
Will get to use edge detection, sharpening → object classification
Relevant to real-world use for environmental good

Concern:
Where to get dataset
What's the interactive part for demo?

We need a project that:
- we can do in 2 weeks
- we can utilize what we learned in this class (and not leaving all the work to a neural network model)
- at least it has some useful aspects (it'd be best if it's useful for sustainability/climate); not just a replica of what people have been doing with generative AI…
- has an interactive aspect for people to play with in demo

Action steps:

Data Collection:

- List the plants we are interested in
- Collect images of various indoor plants under different health conditions (e.g., healthy, overwatered, underwatered, soil problems) from green house
- Create a labeled dataset for training and testing the computer vision model

Image Preprocessing:

- After finalizing the conditions, we should decide on which computer vision technique will best help us for the images - edge detection, image segmentation, Color thresholding
- Try on preprocessing images to enhance visual features and reduce noise

Decision about the ML model:

- Are we training or testing a CNN model - then learning the tensorflow model

Some helpful feature analysis:

Overwatering:

- Image segmentation: Segment the image to isolate individual leaves.
- Color thresholding: Identify pixels within a specific color range indicative of overwatering, such as dark green or brown.
- Texture analysis: Analyze the texture of leaves for signs of edema, characterized by a swollen and blistered appearance.

Underwatering:

- Edge detection: Detect sharp edges of wilting leaves, indicating dehydration.
- Color thresholding: Identify yellow or brown colors on leaves, signifying dryness.
- Shape analysis: Analyze the overall shape of the plant for drooping or wilting due to insufficient water.

Pests and Diseases:

- Image segmentation: Segment the image to isolate lesions, spots, or fungal growth on leaves or stems.
- Texture analysis: Analyze texture changes for signs of fungal infection or insect damage.
- Shape analysis: Detect specific shapes associated with pests or pathogens, such as circular fungal lesions or insect eggs.

Challenges:

- Are we trying to distinguish between the leaves of the trees to decide which tree it is coming from - if not, then how we are handling the user interaction part
- How are we deciding the parameters in edge detection for example?
- Is the first step to try out all the techniques - but how are we going to set goals for that?
- CNN is good for intricate leaf feature detection - so are we giving

Helpful paper:

- https://www.frontiersin.org/articles/10.3389/fpls.2016.01419/full
- https://stackoverflow.com/questions/9374747/optimal-approach-for-detecting-leaf-like-shapes-in-opencv (this discussion was interesting but not directly related to our idea - offers resource like PlantCV?)
- Read the blog about the Seek app (app for plant species detection + healthy/unhealthy signs)