EE/CprE/SE 491 - sddec23-10

Developing a Deep Learning Model to Automatically Detect Microscale Objects in Images and Videos

Week 1~2 Report

01/24/2023 – 02/05/2023
Client : Professor. Santosh Pandey
Group number: 10

Team Members**:**

Katherine Moretina
Ethan Baranowski
Chris Cannon
Matthew Kim

Past week Accomplishments

Group meeting with Client (Professor Santosh Pandey)

Week 1 Meeting

Date	01-30-2023	Team	Sddec23-10		
Participants	Professor Pandey, Team 10				

Topic	Project overview

	내용	Reference
Contents	**1. Request room access first** - Register key(card) first. - Find one place to store stuff. - Welcome anytime to do hw or work on a project. - Will have access to the lab computer. - GPU added soon	Keys.ece.iastate.edu Coover 1050 senior design access
	2. Expectation - Team building - Things that you want to achieve └ Might not directly applied to your field - Patron / Investment pending - Tangible output (github, paper, published) - Think as innovator	Low level Just do the project on face level. High level Find something unique, Publish something.
	3. Project Investment - Investments is needed for the supplies. - Make software < <commercialization - Outcomes will be something that makes money. - Proposal to different foundation > money to the lab	
	4. Project's direct goal - **To see image of the roots to count how many white (parasites' egg) are there. (Soil diagnostic)** • Need to find a way to measure (hard to develop an algorithm, hardware side will be easier.) • Farmers (end user) does not have good internet condition. • Does not have to count exact number. • Currently, drone is the filed that has been developed. (Counting car/people from the image)	Amazon recognition machine learning Kaggle Ex) dip in plants' root into flask.

	Details	Progress Schedule
Objectives	Need to contact graduate student (Yoon Soo, Park) for the next meeting date.	

Group meeting with Assistant (Graduate student, Yun Soo Park)
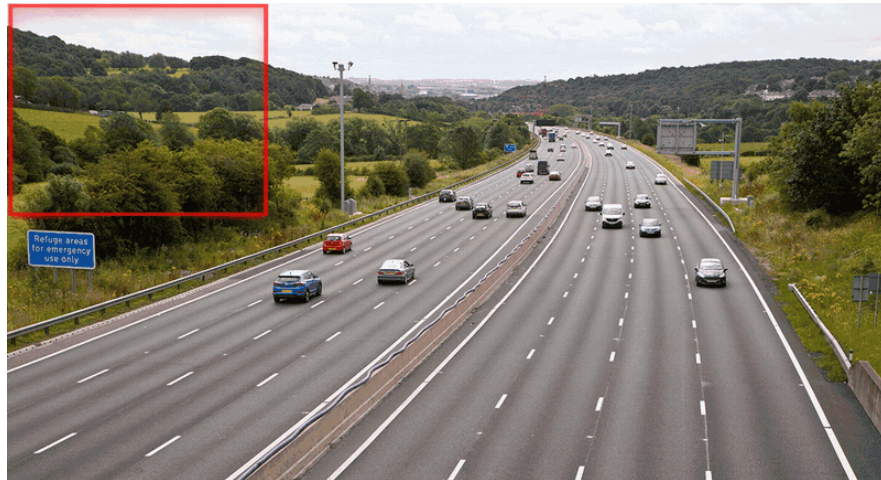
Week 1 Meeting 2

Date	02-01-2023	Team	Sddec23-10		13:00-14:00
Participants	Yun Soo Park (Grad), Team 10				

Topic	Project overview with Grad student.

	Summary	Reference
Contents	**1. Project Goal** - Detect and Count eggs in the image given. - Possible to check how soil is impacted, by counting number of eggs. -	About 1~3 billion dollars per year.
	2. Challenges - Farmers does not have the scanner, but has smartphone. - Smartphone has low resolutions. - Eggs are too small to use pulling and convolution method. (Detect as dust) (ratio too small) - Low percent. (Want about 90%) - Farmers does not have good internet condition (App vs Website) - Very slow	Need labeling and Modeling
	3. Famous Algorithm - Yolo Algorithm (Pytorch) - R-CNN (tensor flow)	Search github "Sahi" Tiling method
	4. Some Tools - AWS (Amazon Recognition) - Edge AI (Autonomous Cars uses this for unsteady internet condition) - HPC iastate	HPC iastate currently on the maintenence.
	5. Things to Search/Study - Small object detection (wiki) - Papers provided through email - Drone (shares field) (Car takes only 6~10 pixel) (Different area image)	

	Details	Progress Schedule
Objectives	Find a next meeting date.	
	Report 1 due 2/5	
	Lab Safety procedures due2/3	

Background information- Everyone

- Read articles given to us by a graduate student that will be helping us with our project.
- Topics included:
    - Small Object Detection- for this project, we will use deep learning methods to detect cysts on images of soybean plants. We will be implementing small object detection algorithms to accomplish this task.
    - Slicing Aided Hyper Interface (SAHI)- a method to aid in small object detection. Finding small objects on a large scale involves many practical usage issues, which are avoided with SAHI. The image below shows a visual representation of how SAHI works.
        -
    - Feature Pyramid Network- a basic component of object recognition systems. It recognizes the features of an image by outputting a multi-level, proportionally sized feature map.
    - Anchor Box Optimization- provides an accurate representation of the bounds of an object being detected. For example, when detecting cysts, thousands of anchor boxes would be drawn around all objects that look similar to cysts, and the AI would determine if the contents in the anchor box is a cyst or not.
    - YOLO- stands for "You Only Look Once." It's a popular algorithm that predicts boundary boxes and finds probabilities simultaneously.

Introductions- Everyone

- Met with our faculty professor, Dr. Pandey
    - Showed us the lab and told us about working in a team
    - Explained project: we are creating a machine learning algorithm that is trained to count the parasitic cysts on soybean roots from a photo/scanner.
    - Ideal use case is for farmers to be able to use an app/program/tool in a remote location and get an approximation of cysts on soybean plants.

- ○ Project minimum is making a working machine learning algorithm. Overachieving would be making an hardware implementation that can apply the cyst counter program.
- ○ Recognized goals of the project- patents, peer-reviewed articles, computer vision vs. hardware aspect of the project

Design Thinking Workshop- Everyone

- ○ Worked through how design thinking affects our project
  - ■ Who, What, When, Where, Why, Why Not, and How
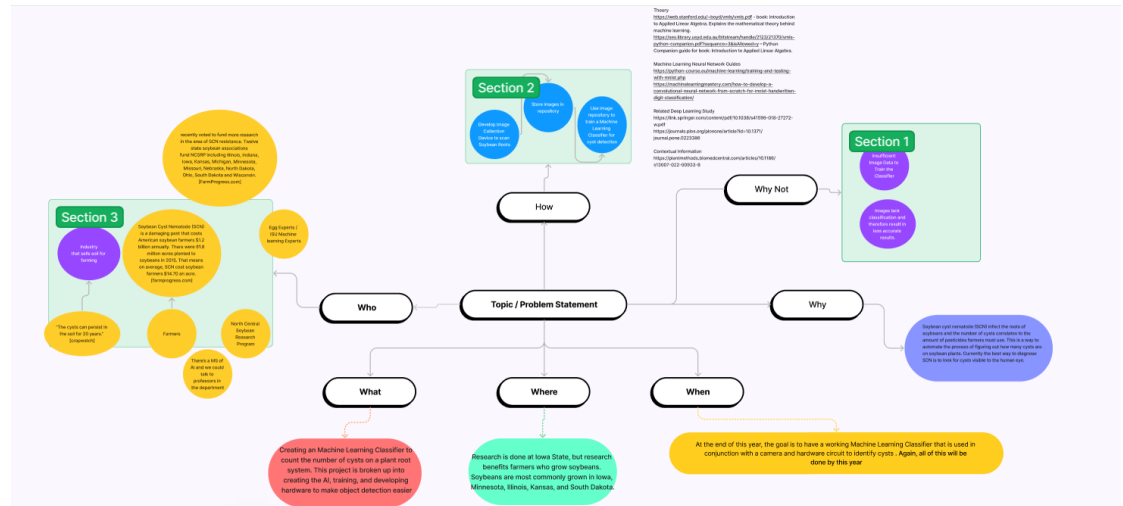
- ○
- ○ This workshop started our research process and helped us identify the importance of our project

Project Background Research

Soybean plants may have parasite eggs attached to their roots. Those parasites attack its host and suck nutrients out of the plant. Therefore, potential yields can be limited. Parasites live in the soil for their entire life, and their size is too small to accurately count by eye.

Therefore, our goal is to implement a way for farmers to check the health of their soil and plants more easily. Farmers will sample plants themselves so that they can send their data to the server or application in order for machine learning algorithms to analyze the health of the soybean.

Picture of cysts of soybean. [dekalbasgrowdeltapine.com]

Individual Contributions

Member	Tasks Completed	Hours This Week	Total Hours
Katherine Moretina	Read all articles given to us by our graduate assistant, reviewed existing code on GitHub	4	4
Matthew Kim	Studied different types of machine learning algorithms, specially Yolo and R-CNN. Read the articles provided by the graduate assistant.	4	4
Chris Cannon	Set up initial meeting with professor, read articles provided by graduate assistant.	2	2
Ethan	Attended Project Orientation meetings, consulted Machine Learning Professor Forrest Bao about relevant machine learning algorithms (suggested clustering Neural Network), reviewed articles provided by TA Yunsoo Park, was granted access to the Coover Lab where the equipment and work stations are.	4	4

Plans for Coming Week

- Set up regular meeting schedule
- Continue background research
- Continue reviewing code given to us by the graduate assistant
- Setup Jupyter Notebooks server for student collaboration
- Setup Github/Gitlab repository
- Label the training data with cyst counts for more accurate modeling
- Study and try to think about labeling and modeling.
  - Need to search which labeling program will fit this project.