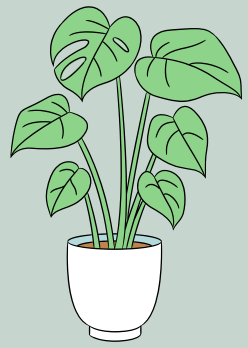
THE INTERNET OF PLANTS

Plant Disease Image Recognition

Gardening has become a top choice of hobbies for many SIngaporeans, especially thanks to the COVID-19 lockdown. Gardening has proven to be a great activity for stress relief and promoting mental resilience. In addition, promoting gardening as an activity would help promote sustainable living and a green lifestyle.



1: Data Collection using ESP32-CAM

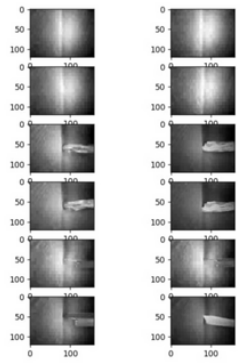
Using the ESP32-CAM, we will collate data where we set the camera to take photos over a duration of 30 seconds.

We will then capture the pandan leaves with different conditions to be used as our dataset.

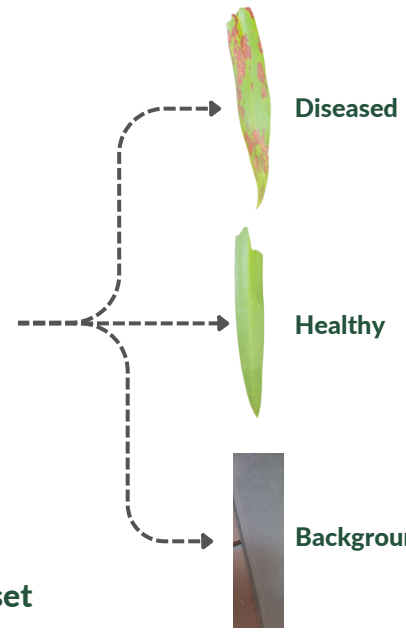
We labeled the images with 3 types of labels: 'Healthy', 'Bad', and 'background'.

This dataset will then be used in the next step.

Different condition of leaves will be captured



Pictures captured will be used as dataset



Pictures in dataset will be labelled

JPEG Image

$$x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ . \\ . \\ . \\ x_n \end{bmatrix}$$

Feature Vector

2: Creation of Image Recognition Pipeline

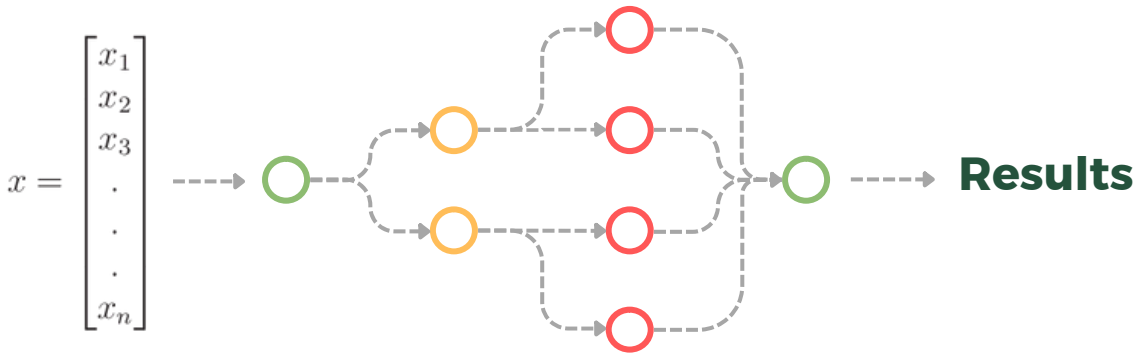
After collecting the dataset of images, we will use the 'everywhereml' package in python to transform each image into something a Machine Learning model can classify.

This is such that the code can be further converted into the C++ language later on.

3: Machine Learning Using Random Forest

Finally, we will train a machine learning classifier with the collected data. We have opted to use the Random Forest model.

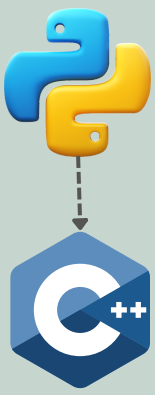
We chose the Random Forest Classifier as it can reduce overfitting by averaging multiple decision trees. It is also less sensitive to noise and any outliers in our training data.



Feature Vector **Random Forest**

4: Conversion of Python to C++ to implement in Esp32

We then need to convert the HogPipeline and RandomForestClassifier code into C++ code for it to run on your Esp32-cam.



5: Scanning with camera module

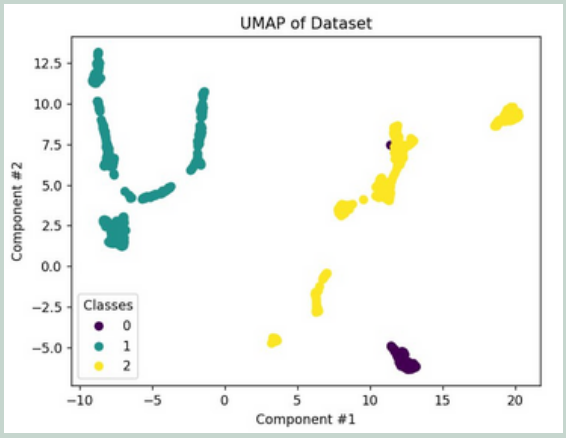
With a database set up, our ESP32-CAM can now predict if the plant is healthy or bad.

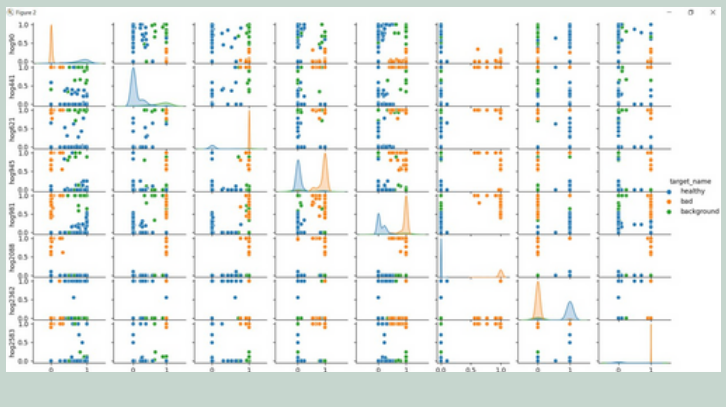
Plant: Pandan (Pandanus amaryllifolius)

Status: Healthy

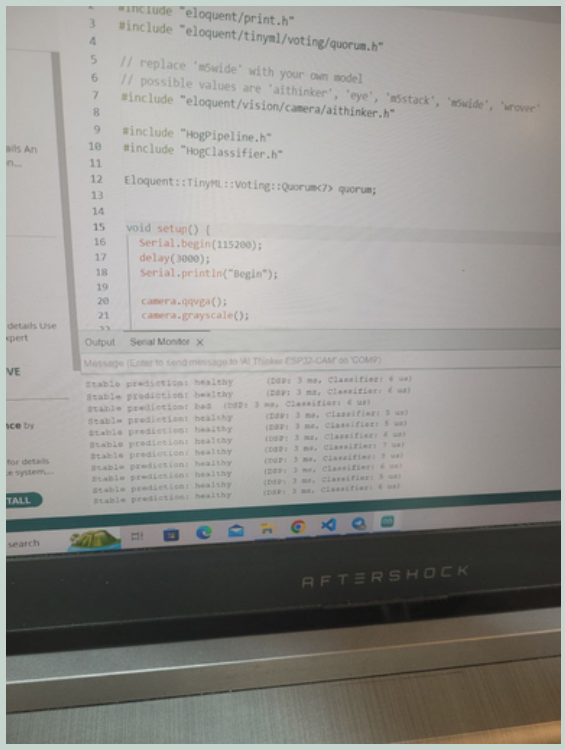
Results:

UMAP (Uniform Manifold Approximation and Projection) of Dataset





Results of test set (Shown on Arduino IDE)



Build UI/UX, Overall Experience

Our device uses a custom lens connected to a ESP32 Camera module and a plant disease database. Users can scan their plants and the device will help to detect symptoms that correspond to various plant diseases. From there, mitigating measures will then be listed out for the user. The device can be connected to our dataset via the internet. The device can also be attached to smart-glasses to free up the hands of gardeners.

Cost

The main module used costs roughly $10 per module. An SQL Server instance with two core and 10.2GB of RAM is priced at $0.5044 per hour (Wayner, 2021). Launching this as an application platform would be viable due to the relatively low material costs.

Scalability: Precision Farming

We aim to promote this device for usage in precision farming. This is because current methods of identifying diseased plants are heavily reliant on human observation, often resulting in the wastage of good plants due to human error and inaccuracies.

With the implementation of our device,
farmers will be able to differentiate healthy plants from diseased plants with higher accuracy.

This will result in an increase in environmental performance and yields. This also results in the reduction of eco-waste and farming costs.

THANK YOU!

E.n.D

SUTD x NUS

References:

ESP32 Image Recognition. (n.d.). Eloquent Arduino. https://eloquentarduino.com/esp32-cam-image-recognition/

Wayner, P. (2021, March 12). What is the total cost of owning a database? VentureBeat. https://venturebeat.com/business/what-is-the-total-cost-of-owning-a-database/