Imperial College London

MSc Computational Methods in Ecology and Evolution

Identifying spectral bioindicators of pollination using machine learning algorithms

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1 Keywords

Flower; Pollination; Spectral Reflectance; Machine Learning; Target Detection; Instance Segmentation

2 Introduction

The process of pollination is critical for plant health and importantly for us, the production of fruits and seeds. Thus, understanding when and where plants have been pollinated is important for predicting food production and mitigating pollination deficits. However, since we cannot determine whether a flower is pollinated by the naked eye in the short term, a non-invasive tool could transform our way of assessing pollination at the landscape level.

Recently, spectrograms of light reflected from plant tissues have been shown to reveal changes in plant tissues in response to disease and other stressors. Imaging data is also increasingly being used for plant monitoring, and machine learning techniques can be used to identify subtle changes in plant reflectance captured in photographs.

There are many, well-documented, ways to deal with image data. (Minaee et al. 2022) Among deep learning models, the most prominent one is convolutional neural network (CNN) (Chua & Roska 1993) CNN models are built to evaluate its performance on image recognition and detection datasets. (Chauhan et al. 2018) The recent Mask R-CNN is a target detection algorithm that is based on an improved version of the Faster R-CNN algorithm by adding a branching network that allows it to achieve target instance segmentation while preserving the performance of target detection.(He et al. 2017)

In this project, we will focus on Mask R-CNN approach with a large image dataset to identify spectral signatures captured which can be used to distinguish pollinated from unpollinated flowers.

3 Methods

To start the project, we are supposed to extract the features from the large image dataset. An algorithm is then applied to recognise the QR code in order to read the label. After processing the data, train a Mask R-CNN model and adjust the model. Transfer learning method may be used here to address the problem of small data samples.(Khan et al. 2021)

4 Anticipated outputs and outcomes

Ideally, a high-performance machine learning algorithm will be written to extract features from images, and identify spectral signatures captured which can be used to distinguish pollinated from unpollinated flowers. This technique will be a non-invasive tool to assess pollination at the landscape level.

5 Project feasibility

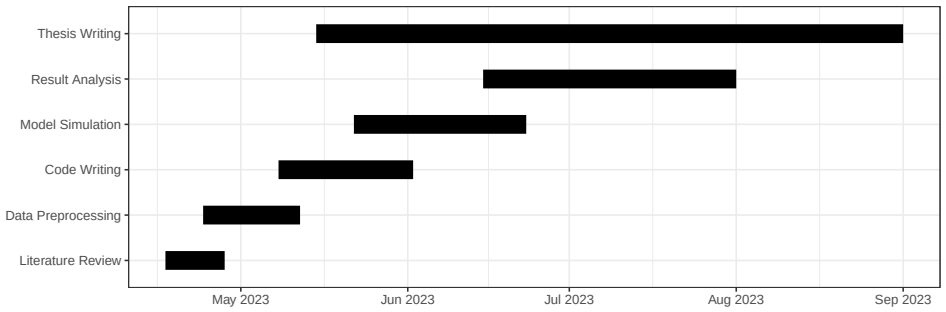

Figure 1: Gantt chart of the general project plan.

6 Itemized Budget

No budget anticipated.

References

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I have seen and approved the proposal and the budget.

Supervisor: Richard Gill

Signature:

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