**A Deep Learning based app to monitor biodiversity in East London**

A Grant Proposal from *FloraFrames*

Background and motivation

Having had a dazzling success with its maiden Kew Gardens project, FloraFrames wishes now to return to its roots by launching another project for the East London environment associated with its research affiliate Queen Mary University of London (QMUL).

One study, by Houlden, de Albuquerque, Weich & Jarvis (2019) found that access to green spaces correlated with increases in life satisfaction and happiness indices. In East London investment in green space has been lower than that of West London, attracting accusations that a root cause of this is socioeconomic status (Smith, 2010). Furthermore, a study by Friends of the Earth (2020a) suggests a negative correlation between prevalence of Black Asian and Ethnic Minority (BAME) groups and the degree of Green Space availability as shown in Figure 1. Figure 1 shows areas of East London close to QMUL, such as Newham and Tower Hamlets, as having the highest percentages of English BAME populations and experiencing the highest areas of Green Space Deprivation. Reflecting on this it seems unfortunate and unfair that green spaces are less available for certain communities than for others.

A graph with a line and dots

Description automatically generated with medium confidence

Figure 1-A scatter plot graph that depicts the relationship between green space deprivation rating and the percentage of the BAME (Black, Asian, and Minority Ethnic) population in various English local authorities (Friends of the Earth, 2020b)

These studies build a strong case to preserve Green Spaces within East London. Ongoing efforts to enhance biodiversity (SUGi Project, n.d.; Queen Elizabeth Olympic Park, n.d.; Hackney Council, n.d.), assessing the impact of these initiatives remains challenging for cash strapped local councils (CPRE, 2024). FloraFrames aims to provide a low-cost scalable Deep Learning (DL) AI method to facilitate the monitoring of biodiversity preservation efforts.

Results of our previous project

FloraFrames’ maiden project revolved around building a Computer Vision (CV) model upon a novel dataset curated from the diverse range of plants at Kew Gardens, London. On reflection our success was built upon having practiced our sampling strategy at the site of QMUL, so when we did sample ‘in the field’ it was an efficient process with most of the images taken being appropriate for later use. There was confusion however, when reviewing our images in the computer labs, as some images had both overlapping features and unclear labelling, requiring review as to what was the intended class of image. Going forward we will explore if there is any option of tagging the photographs as they are taken so that the class of image (e.g. stem or whole plant) is made explicit. In addition, we found that despite being efficient we still had plenty more plants to sample. We also found that a team consisting only of botanist and photographer was sufficient. Putting these reflections together we recommend that future teams be halved in size and doubled in number for maximum efficiency and scaling. On similar principles, in later stages of our project, we hope to both streamline and scale up our data collection by utilising the power of large numbers of ‘citizen scientists’.

Research Plan

Building on the potent idea of citizen empowerment (Keyles, 2018) and inspired by the projects such as iNaturalist (iNaturalist, 2021), Global Biodiversity Information Facility (DCNA Nature, 2020), we also propose using a smartphone app which will automatically geo-tag images that users have taken on their smartphone. We also suggest curating geotagged, timestamped images from social media, as well as encouraging footage taken safely from drones. We will have an initial target study in Queen Elizabeth Park to test the principle and refine the process. We will replicate our previous trip to Kew Gardens but try and amend the methodology as we have reflected on above.

A diagram of a data processing process

Description automatically generated

Figure 2- A flowchart detailing the workflow of the data processing of our proposed project (Microsoft Corporation, 2021).

Because we already have a dataset from Kew Gardens and intend to gather more local plant information through additional field studies, we will have an initial set of training data for identification.

Figure 2 shows how after combining our many sources of data, we will use the fast.ai libraryt (as suggested for ResNet architectures by de Menezes, de Lima, Feitosa, Gomes, and Jacob (2021)), to transform our images and increase our dataset further. From there we believe we sufficient dataset to develop a DL AI model called a Convolutional Neural Network (CNN), which will have a ResNet architecture-appropriate for Computer Vision applications.

Expected results

The expectation is that this DL method can automatically identify plant species with a degree of accuracy approaching human experts. We expect to gain a wealth of data as the AI identifies plants and helps to assign biodiversity scores in each area, as shown in Figure 2, ready for statistical analysis. Overlaying this on a Geographic Information System (GIS) will generate maps of target areas so that councils can chart their projects over time and see what is working.

This study is likely to provide valuable insights into the resilience and adaptability of urban flora, contributing to the development of more precise AI models for biodiversity monitoring. Our AI models, tailored to incorporate an expanding dataset, are expected to become more robust and accurate, enabling us to better understand and manage urban ecological systems. Through our FloraFrames app and its ‘citizen scientist’ ethos, we also hope to foster a civic pride in preserving local green spaces.

References

de Menezes Neto, E.J., de Lima, D.G., Feitosa, I.S., Gomes, S.M. and Jacob, M.C.M., 2021. Plant Identification Using Artificial Intelligence: Innovative Strategies for Teaching Food Biodiversity. In Local Food Plants of Brazil (pp. 379-393). Cham: Springer International Publishing. <https://link.springer.com/chapter/10.1007/978-3-030-69139-4_19>

DCNA Nature, 2020, Millions of sightings by citizens contribute to mapping Biodiversity, <https://dcnanature.org/bionews38-mapping/>

Friends of the Eartha, 2020. The Green Space Gap. [pdf] Friends of the Earth. Available at: <https://policy.friendsoftheearth.uk/sites/default/files/documents/2020-10/Green_space_gap_full_report_1.pdf> [Accessed 29 February 2024].

Friends of the Earthb, 2020. [scattergraph] The Green Space Gap. [pdf] Friends of the Earth. Available at: <https://policy.friendsoftheearth.uk/sites/default/files/documents/2020-10/Green_space_gap_full_report_1.pdf> [Accessed 29 February 2024].

Habitats and Heritage, n.d., Citizen Science: Monitoring Wild Flower Abundance on Roadside Verges, https://habitatsandheritage.org.uk/get-involved/our-projects/citizen-science-project-monitoring-wild-flower-abundance-on-roadside-verges/

Hackney Council, n.d. Biodiversity and Nature Conservation. [online] Available at: <https://hackney.gov.uk/biodiversity-and-nature-conservation> [Accessed 29 February 2024].

Houlden, V., de Albuquerque, J.P., Weich, S. and Jarvis, S., 2019. A spatial analysis of proximate greenspace and mental wellbeing in London. Applied Geography, 109, p.102036. https://eprints.whiterose.ac.uk/150645/1/spatial%20analysis%20of%20proximate%20greenspace%20and%20mental%20wellbeing%20in%20London.pdf

iNaturalist, 2021, KUNHM Autumn BotanyBlitz, iNaturalist, <https://www.inaturalist.org/projects/kunhm-autumn-botanyblitz>

Keyles, S. 2018, Citizen Science, Important Tool for Researchers, Science Connected Magazine, September 13, 2018, <https://magazine.scienceconnected.org/2018/09/citizen-science-important-tool/>

Microsoft Corporation, 2021. Microsoft PowerPoint [software used to create diagram]. Version 16.x. Redmond, WA: Microsoft Corporation.

Smith, D., 2010. Valuing housing and green spaces: Understanding local amenities, the built environment and house prices in London. GLA Economics, <https://www.london.gov.uk/media/75128/download>

SUGi Project, n.d. East London Natura Nostra Forest. [online] Available at: <https://www.sugiproject.com/forests/east-london-natura-nostra-forest> [Accessed 29 February 2024].

Queen Elizabeth Olympic Park, n.d. Environmental Sustainability: Biodiversity. [online] Available at: <https://www.queenelizabetholympicpark.co.uk/about-us/environmental-sustainability/biodiversity> [Accessed 29 February 2024].