URBAN TREE SPECIES CLASSIFICATION USING AERIAL IMAGERY

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EMILY WATERS, MAHDI MAKTABDAR OGHAZ, LAKSHMI BABU SAHEER

FACULTY OF SCIENCE AND ENGINEERING, ANGLIA RUSKIN UNIVERSITY, CAMBRIDGE, UNITED KINGDOM

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- **BACKGROUND**

- Trees play a key role in climate change mitigation by capturing, storing and consequently reducing atmospheric CO_2 levels, the main adverse contributor to greenhouse gases and climate change (Aitken *et al.*, 2008).

- Urban trees can cut heating costs by reducing wind-speed and casting shade around the housing area which indirectly mitigates emission of greenhouse gases (Wolf, 2005).

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- **MOTIVATION**

- To leverage what trees can potentially offer, effective forest and urban tree management is essential.

- Effective forest and urban tree management requires detailed information about tree species, composition, health and geographical location of each tree in order to create a long-term sustainable plan for plantation and forestation sites, pruning schedules and mitigation of potential problems (Baeten & Bruelheide, 2018).

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- **MOTIVATION**

- Effective forest and urban tree management also helps to monitor tree species diversity and track health and growth rate to creates a more robust ecosystem with better productivity and greater resilience to disease and pests (Gamfeldt *et al.*, 2013).

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- **AIM**

- This study is aims toward creating an accessible, reliable yet economically and practically viable tree management system to automatically detect, classify species and monitor forests and urban trees.

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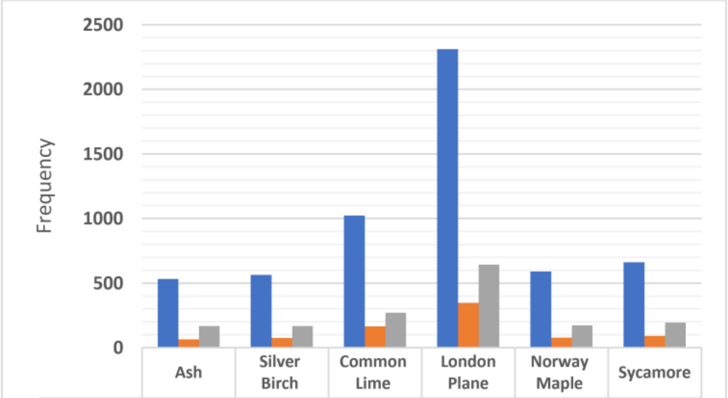
- **DATASET**
- This study offers a dataset that uses Google Map's static API to source trees' aerial images and Camden tree inventory to supply tree's GPS location and species information.

Camden

Trees in Camden Inventory

Google Map Images

Sample Images from Dataset



	Ash	Silver Birch	Common Lime	London Plane	Norway Maple	Sycamore
Train	532	565	1024	2311	589	662
Test	64	75	166	348	79	92
Validation	167	167	272	642	173	193

Dataset Statistics

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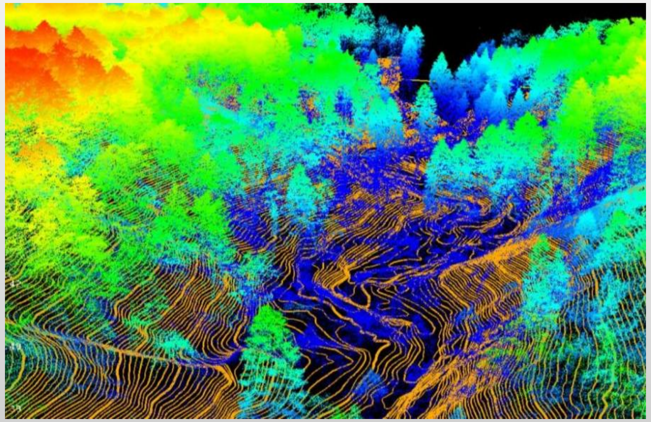
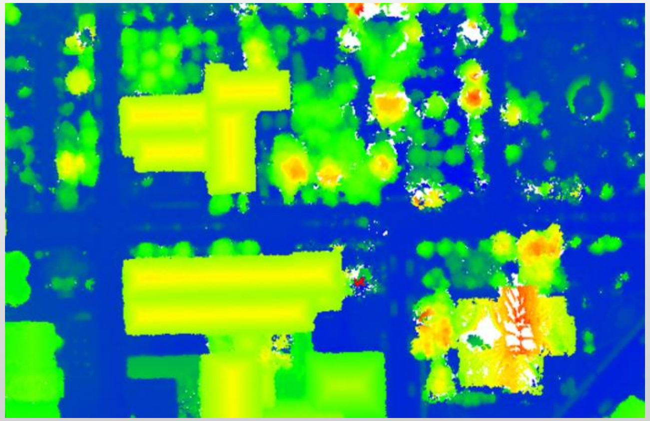
- **LITERATURE REVIEW**

Ground Surveying



LiDAR technology



Hyperspectral imaging

- Laborious
- Time-consuming
- Expensive

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- **METHOD**

- This research investigates and evaluates **three** possible deep models including:
  - **VGG-16 (Pre-trained and Fine-tuned)**
  - **ResNet50 (Pre-trained and Fine-tuned)**
  - **Custom Deep Models (Training from scratch)**

- Parameters to Investigate:
  - **Dropout, Class Weights, Optimizer, Initializers**

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- **METHOD**

- **Custom Deep Models:**

- N is the number of Convolutional blocks, ranges between 1 and 6, with each block consisting of two convolutional layers (CONV) with a ReLU activation function followed by a Max-pooling layer.

$$INPUT \rightarrow$$
$$[[CONV \rightarrow RELU] * 2 \rightarrow MAXPOOL] * N \rightarrow$$
$$[FC \rightarrow RELU] \rightarrow FC,$$
$$whereN \in \{1, 2, 3, 4, 5, 6\}$$

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- **QUANTITATIVE RESULTS**

Model	Loss	Accuracy (%)	Avg Class Recall (%)	Avg Class Precision (%)
VGG -16 (20% dropout - Adam)	1.1649	57.16	42.65	45.30
ResNet50 (20% dropout - Adam)	0.7300	59.92	54.07	52.46
x6 Conv block (Adamax He-normal)	0.8836	69.54	57.41	62.75
x6 Conv block (Adamax Truncated-normal)	0.9490	66.75	53.31	58.93
x5 Conv block (Adamax He-normal)	0.9254	67.11	55.74	58.97
x3 Conv block (5x5 Kernel - Adamax He-normal)	1.2031	54.98	39.17	44.19
x6 Conv block (Adamax Lecun - uniform)	0.9440	66.14	51.56	60.76
x6 Conv block (Adamax He-normal) 5-fold Cross Val	-NA-	60.29	46.57	56.18

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- **QUALITATIVE RESULTS**

Species	Correctly Classified Samples	Misclassified Samples
Ash		
Silver Birch		
Common Lime		
London Plane		
Norway Maple		
Sycamore		

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THANK YOU