Convolutional Neural Network Model Building For Future Medicinal Plant Recognition

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RESEARCH PROJECT 2022

OUTLINE

Research Aim

Topic 1: Feature Extraction Methods

Topic 2: Plant Classification Models

Topic 3: Existing Datasets

Topic 4: Previous Attempts

Topic 5: Final Research Steps

Topic 6: Future Work

RESEARCH AIM

- South Africa still uses traditional medicine
- Overuse of these plants requires conservation measures
- Plant identification aids in plant taxonomy
- Create methods that can be used on a future South African dataset

01

Feature extraction methods

Feature extraction methods

Shape

Texture

Veins

CNN’s

02

Plant classification models

Plant classification methods

1
RFC

Fits several decision tree classifiers on various sub-samples of the dataset and uses averaging to improve the predictive accuracy and control over-fitting.

2
KNN

Finds distances between a query and all the examples in the data, selecting the specified number of examples (K) closest to the query, then votes for the most frequent label

3
SVM

Finds a hyperplane in an N-dimensional space(N — the number of features) that distinctly classifies the data points

4
MLP

A deep artificial neural network that learns the relationships between linear and non-linear data

5
CNN

Works by getting an image, designating it some weightage based on the different objects of the image, and then distinguishing them from each other

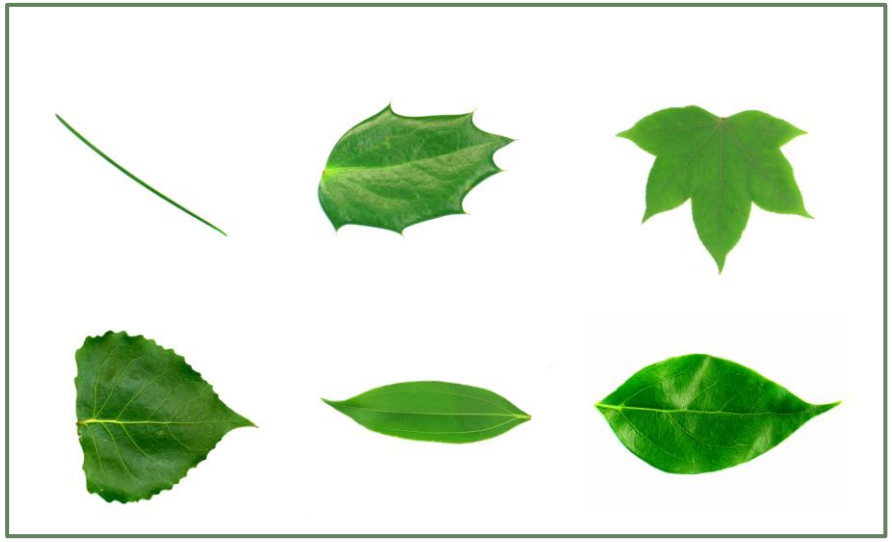
03

Existing datasets

EXISTING DATASETS

FLAVIA

- 1907 images
- 32 species



Six samples from the Flavia dataset

EXISTING DATASETS

SWEDISH LEAF

- 1125 images
- 15 tree classes

Fifteen samples from the Swedish Leaf dataset

EXISTING DATASETS

MENDELEY HEALTHY AND DISEASED

- 4503 images
- 12 tree classes
- 2278 healthy leaves
- 2225 diseased leaves

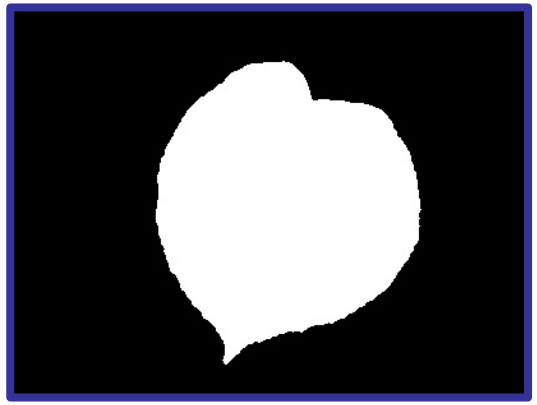
Six samples from the Healthy and Diseased dataset

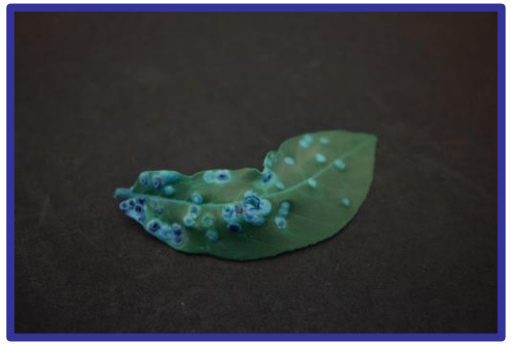
ImageNet, Intelligent Computing Laboratory (ICL), The Plumbers Island and many more…

04

Previous attempts

PREVIOUS ATTEMPTS





- Bounding box selection
- Cropping of image
- Use of GrabCut Algorithm
- Gaussian Blur
- Features extracted e.g., contour width etc.

05

Final Research Steps

Research Steps

The following steps were done:

Deciding on Dataset

Flavia and the Healthy and diseased dataset was chosen

Deciding on features

RGB, HSV and Grayscale, with data augmentation applied to the best performing of the three

Creating a model

Images were resized to increase speed and passed through many convolutional and pooling layers

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_4 (Conv2D)            (None, 148, 148, 32)      896

max_pooling2d_4 (MaxPooling  (None, 74, 74, 32)        0
2D)

conv2d_5 (Conv2D)            (None, 72, 72, 64)        18496

max_pooling2d_5 (MaxPooling  (None, 36, 36, 64)        0
2D)

conv2d_6 (Conv2D)            (None, 34, 34, 128)       73856

max_pooling2d_6 (MaxPooling  (None, 17, 17, 128)       0
2D)

conv2d_7 (Conv2D)            (None, 15, 15, 128)       147584

max_pooling2d_7 (MaxPooling  (None, 7, 7, 128)         0
2D)

flatten_1 (Flatten)          (None, 6272)              0

dense_2 (Dense)              (None, 512)               3211776

dense_3 (Dense)              (None, 22)                11286

=================================================================
Total params: 3,463,894
Trainable params: 3,463,894
Non-trainable params: 0
_________________________________________________________________
```

Research Steps

The following steps were done:

Deciding on Dataset

Flavia and the Healthy and diseased dataset was chosen

Deciding on features

RGB, HSV and Grayscale, with data augmentation applied to the best performing of the three

Creating a model

Images were passed through many convolutional and pooling layers

Altering of model

More/ less layers were experimented with to see which performed better until the model was finalised

Evaluation

Categorical cross-entropy and early stopping was used, along with the Adam optimizer to accelerate learning

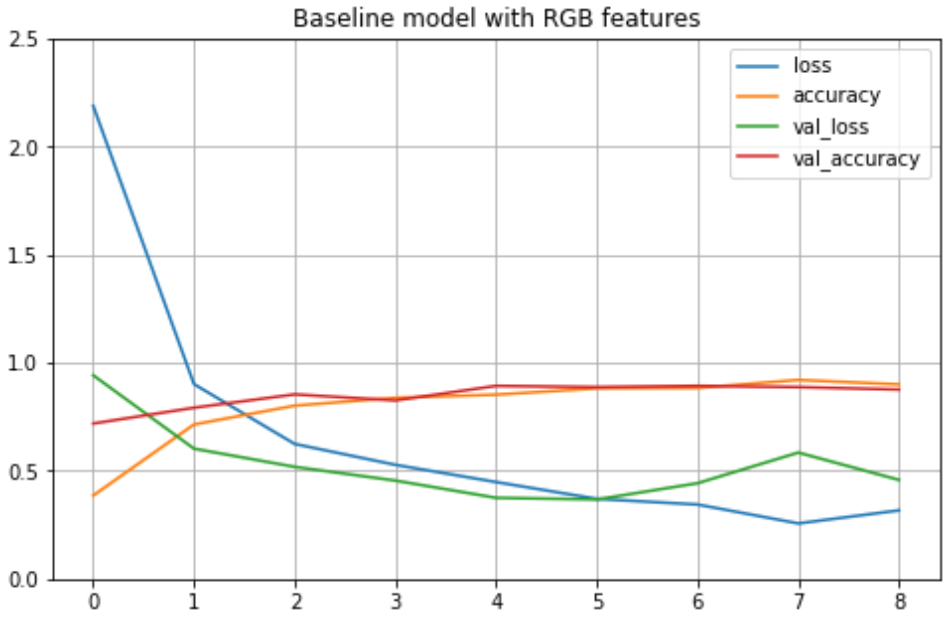
Results

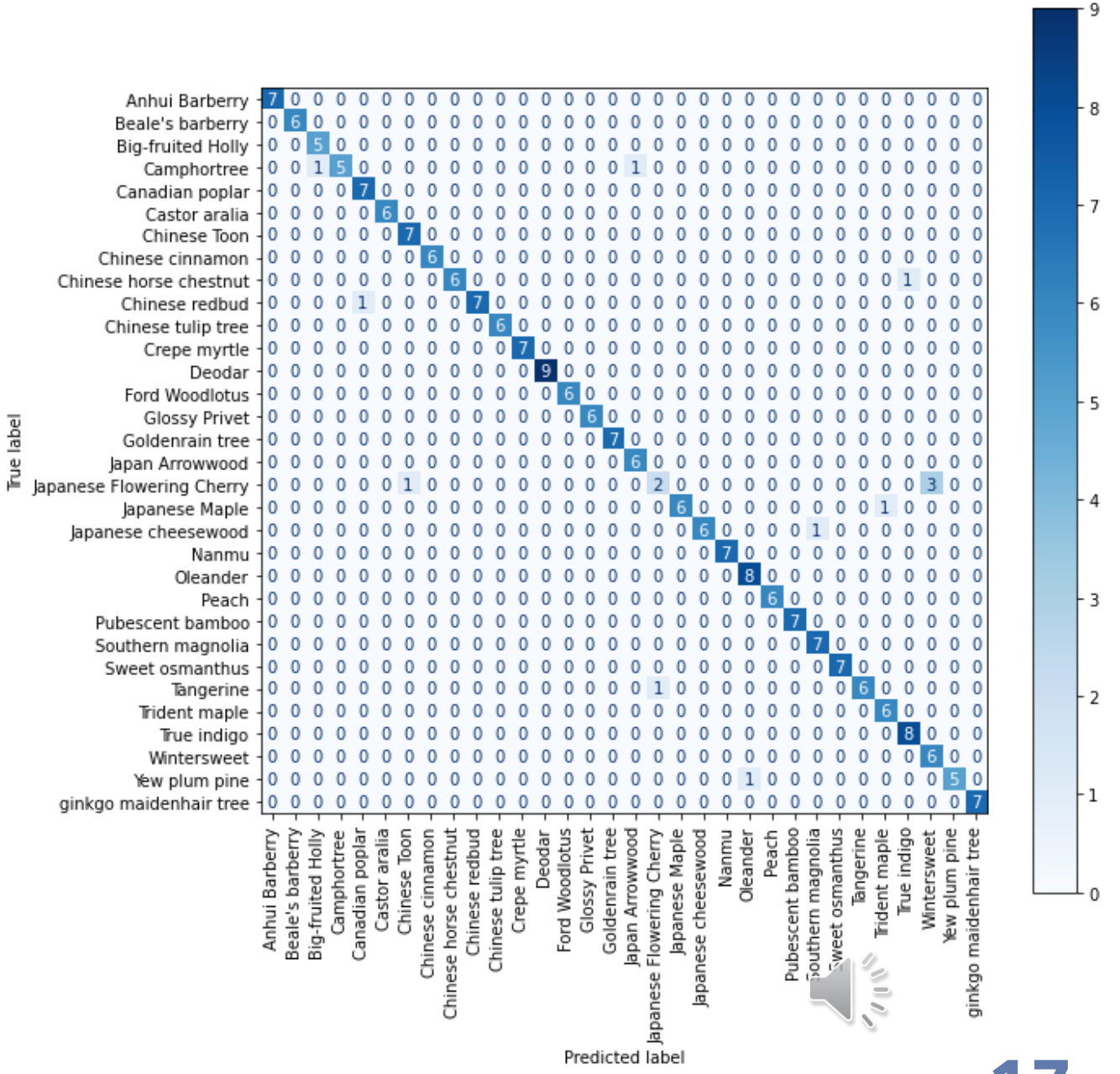
Accuracy, validation loss and training loss was calculated

Best performing Flavia model

RGB + slight translation invariant features

Accuracy: 94,42 %

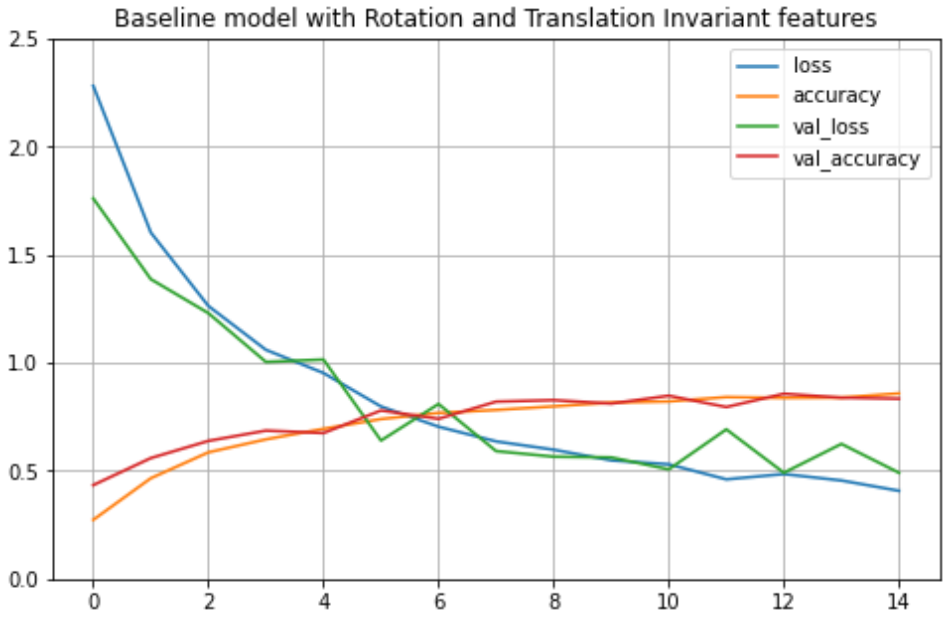


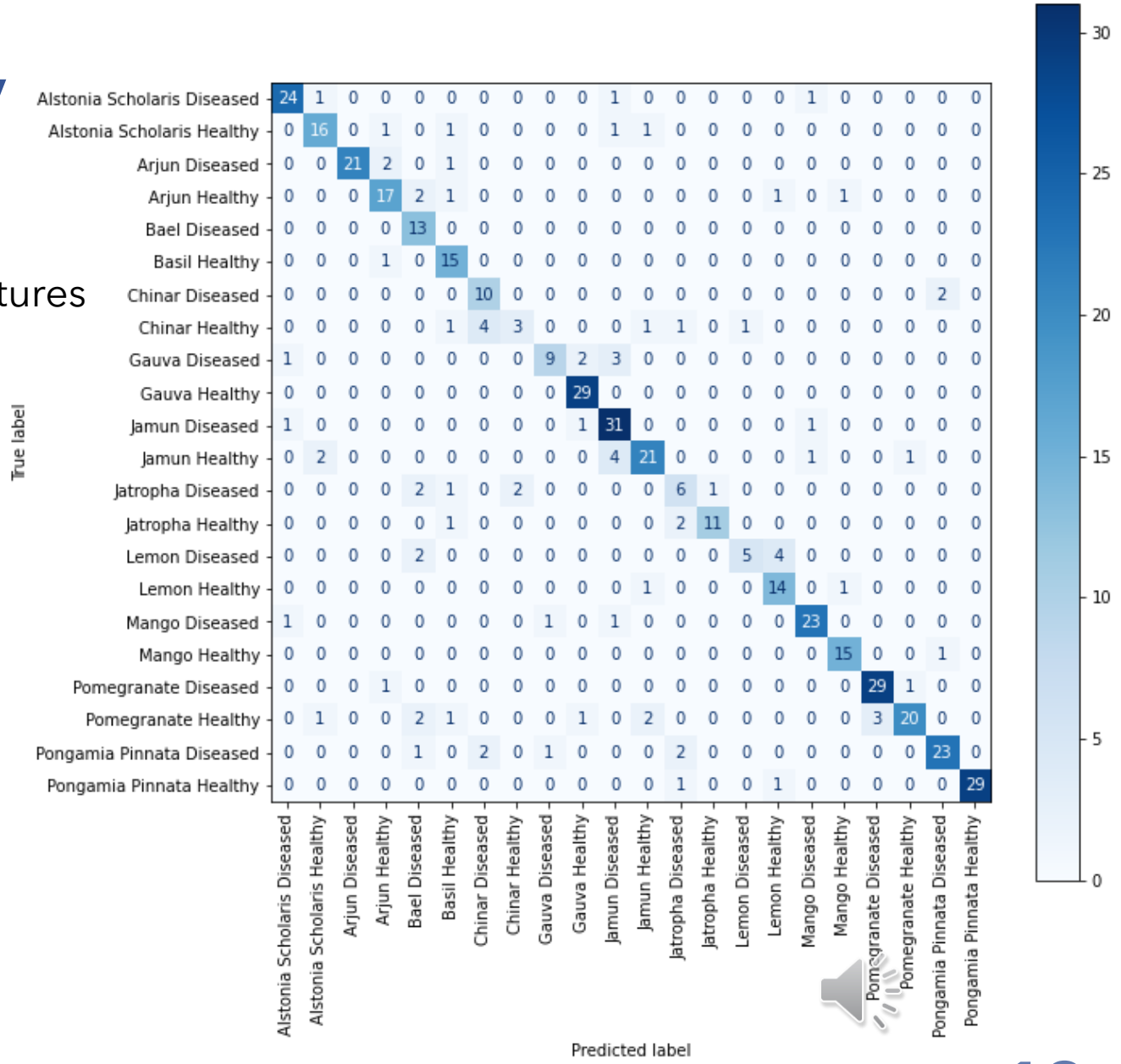


Best performing Healthy and Diseased model

HSV + slight translation and rotation invariant features

Accuracy: 82.05%





06

Future Work

FUTURE WORK

- Create a South African dataset!
- Attempt Transfer Learning e.g., AlexNet, VGG-16
- Add more to the feature sets e.g., shape outlines
- Experiment with more invariance of features

Contact info

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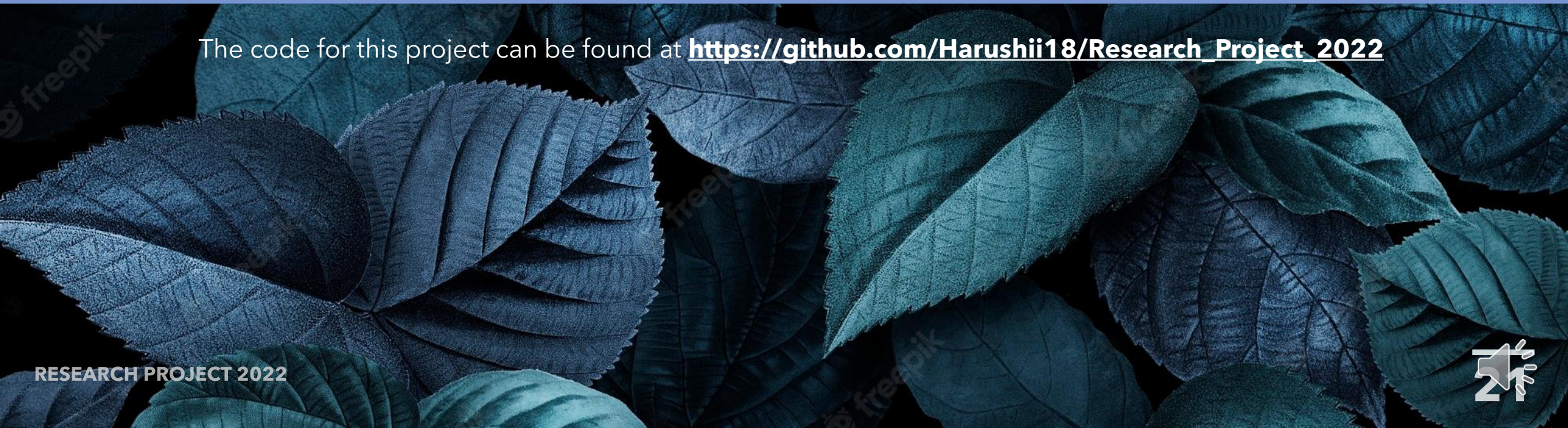

The code for this project can be found at **https://github.com/Harushii18/Research_Project_2022**