LYU1802
BotanWiki

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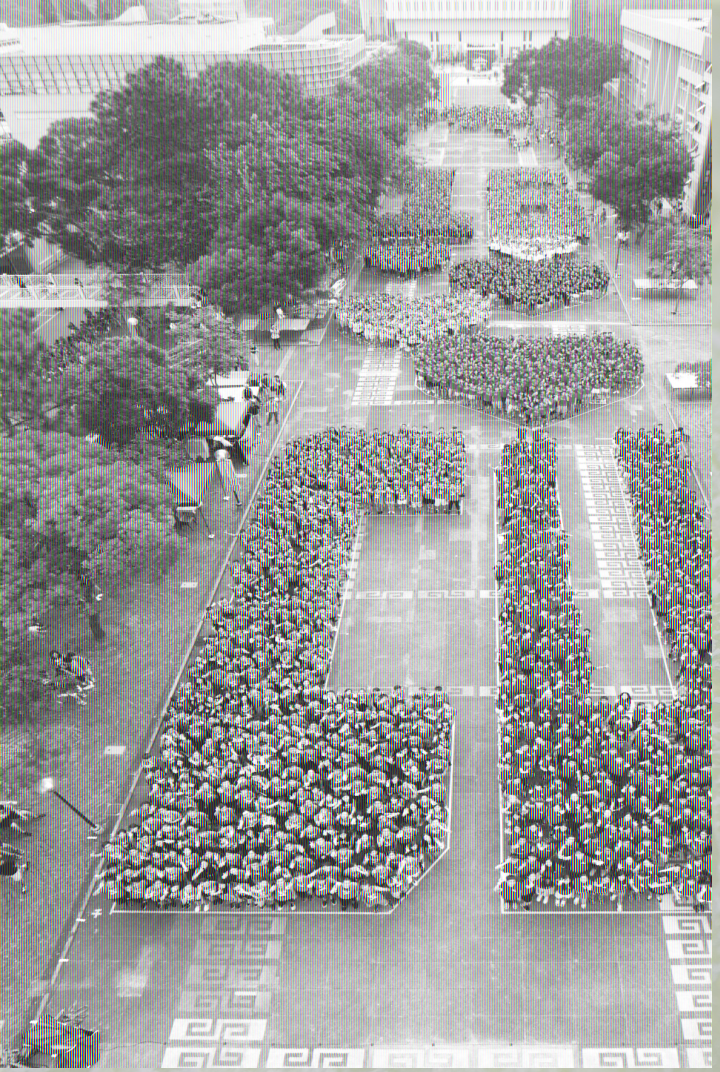
Supervised by Prof. Lyu Rung Tsong Michael



Motivation

Beautiful campus

With high variety of plants

Significance

- For bontanists, reduce their workload massvie data → quick recogintion
- For public, countryside to check the plant
- Offline, stable performace in rural area
- Education purpose for students or children

Goal

We would like to build an **offline** leaf recognition **mobile application**, a **sustaniable platform** about plants recognition.

Technology Overview

- OpenCV and keras
- TensorFlow
- Android Studio
- Gitlab

Timeline

Sep

Preparation Work
1. Target Setup
2. Interview with Curator David Lau
3. Begin Data collection

Oct

Prototyping
1. PyTorch: ResNet (~70%)
2. Get familiar with TensorFlow
3. Get familiar with Android App: Live Recognising

Nov

Enhancement
1. Data Augmentation
2. MobileNet (More than 90%)
3. 1st Version of Mobile Applicaiton: Dr.Leaf

Dec

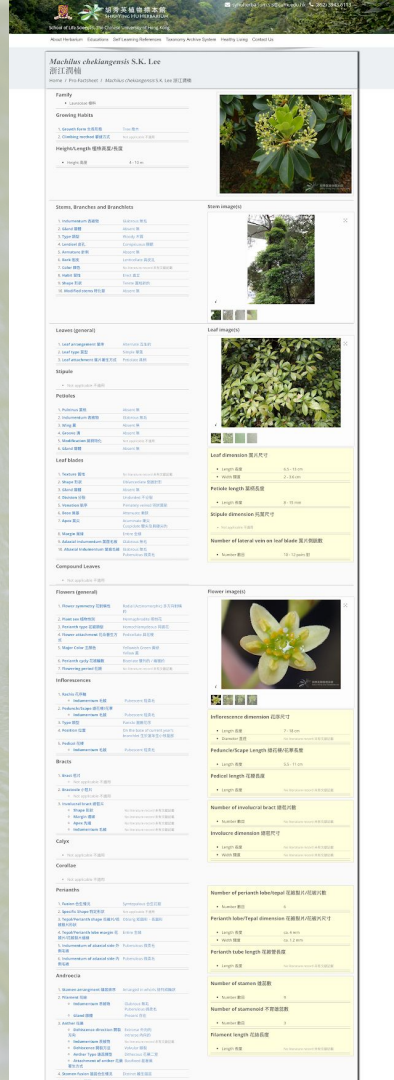
Presentation and Demonstration

Knowledge on recognizing plants by leaf

To recognize a plant in an scientific way,

- Growing habit, habitat
- Stem and branches
- Flower
- Fruit
- Leaf

Difficult to classify with leaves only.



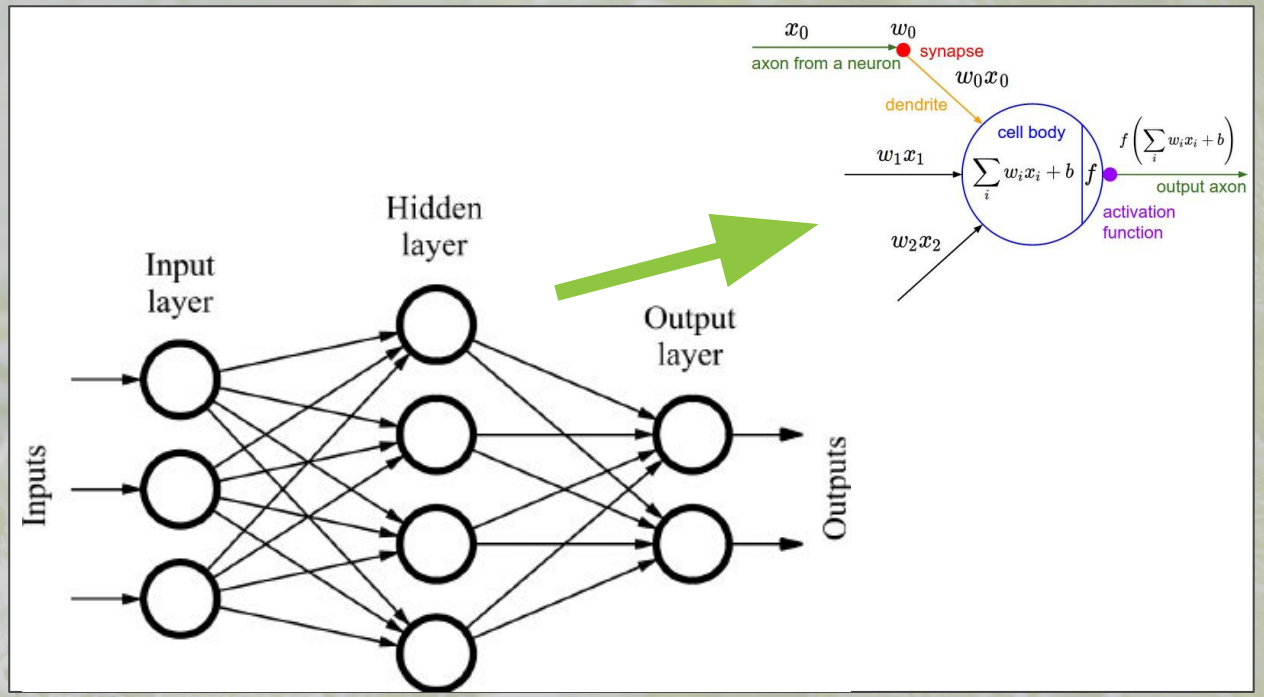
AI Model

Problem Defining and Solution

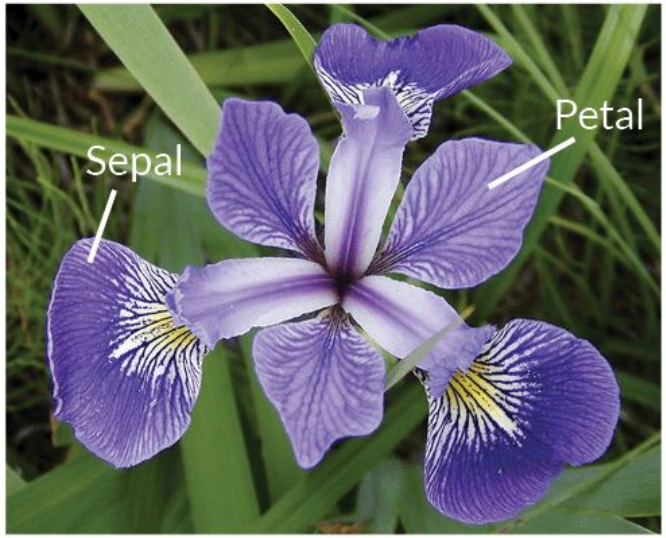
- Classification Problem

- Classify by comparing the features

Neural Network



Neural Network

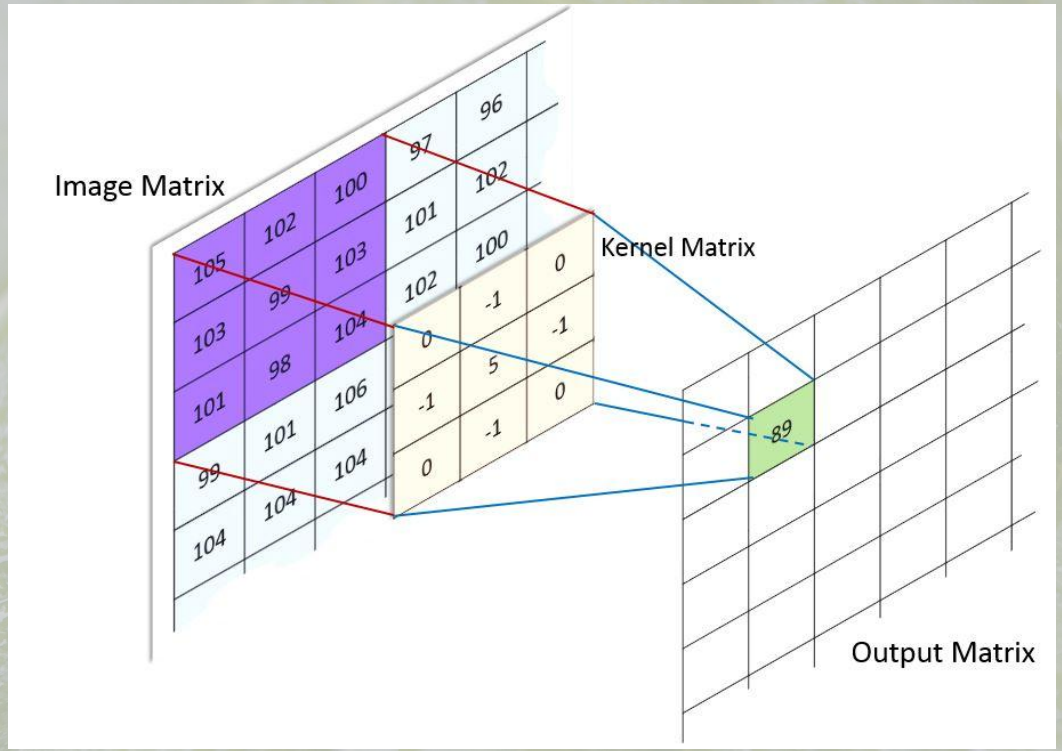


Iris Versicolor

Iris Setosa

Iris Virginica

Convolutional Neural Network



Convolutional Neural Network

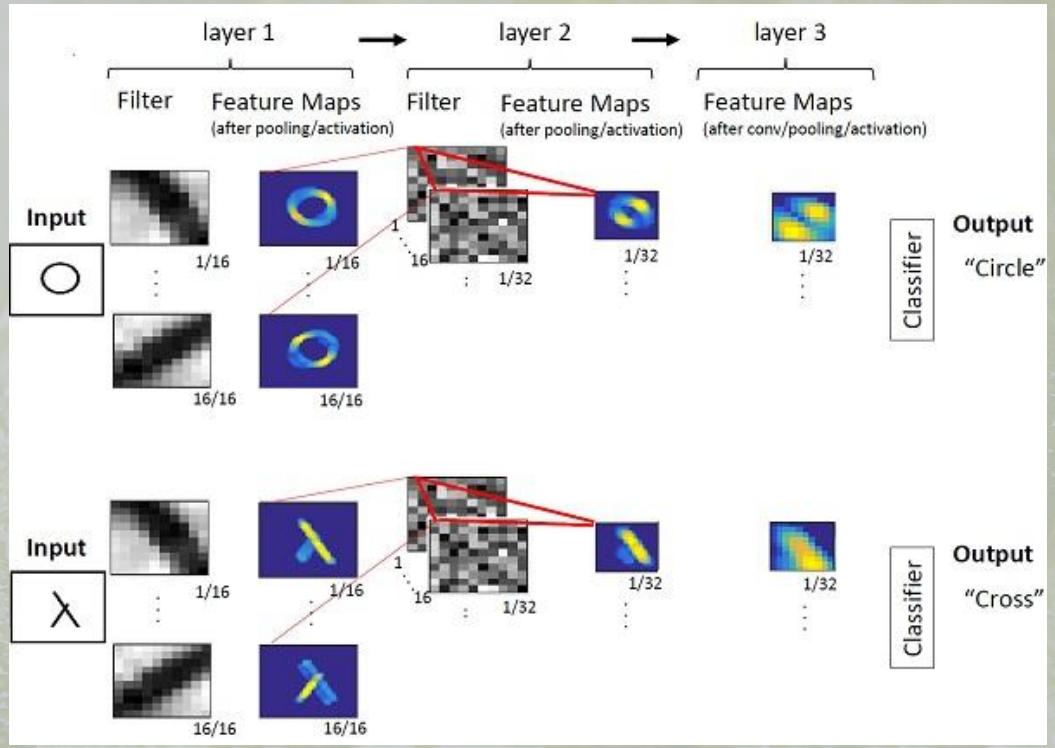
Input image

Convolution Kernel

$$\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$$

Feature map

Convolutional Neural Network

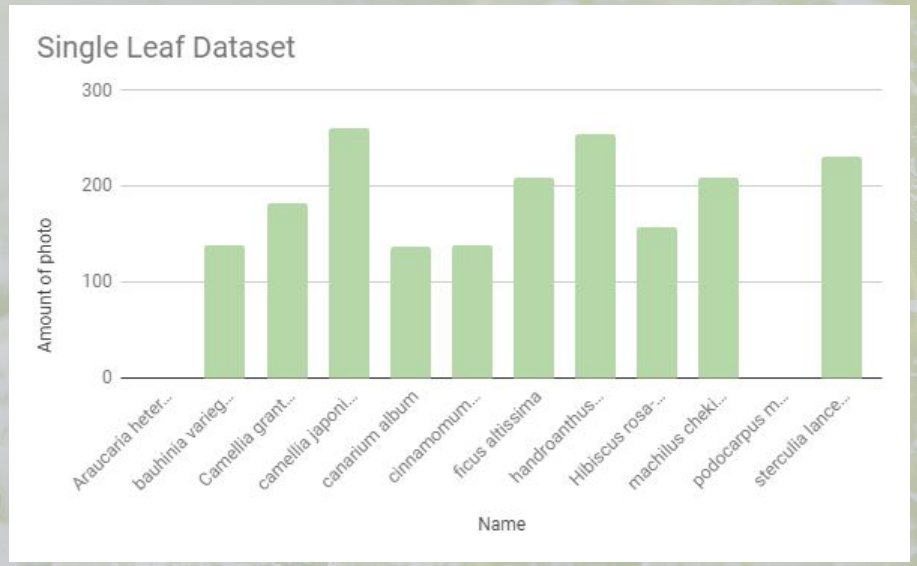


Data Preparation

- Take Photos

- Divide into single leaf set and multiple leaves set

Data Preparation




cg00000.png


cg00001.png

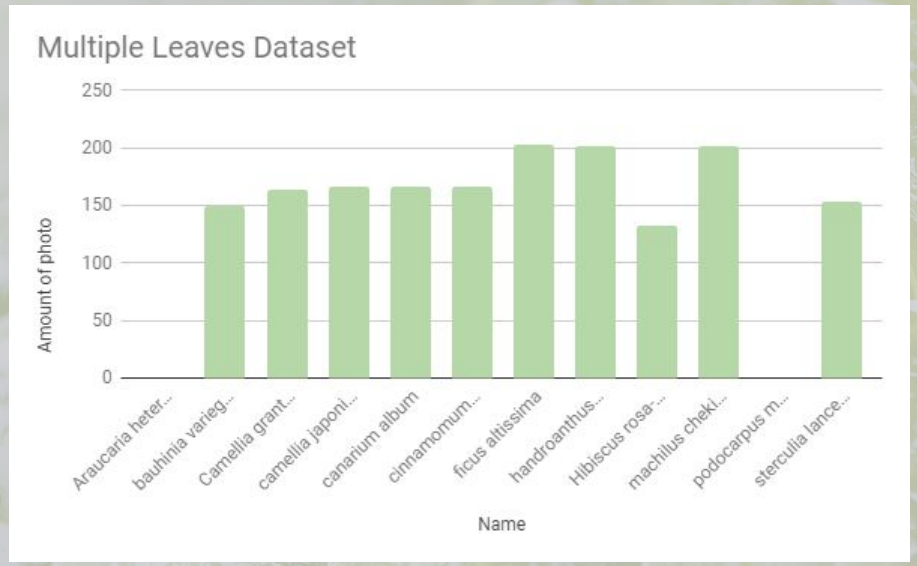

cg00005.png


cg00006.png


cg00013.png


cg00016.png

Data Preparation




cg00001.png


cg00002.png

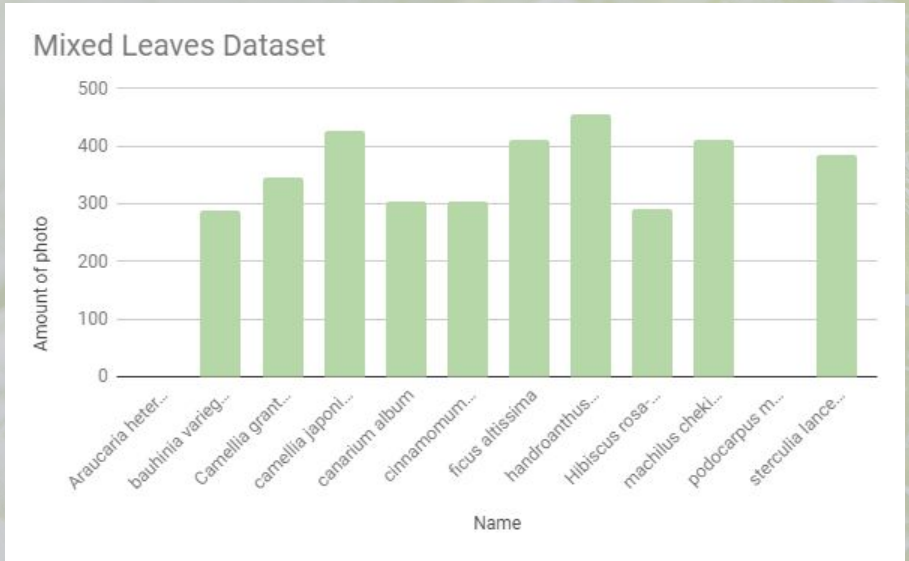

cg00006.png


cg00007.png


cg00011.png


cg00012.png

Data Preparation




ca00161.jpg


ca00162.jpg


ca00166.jpg


ca02000.jpg

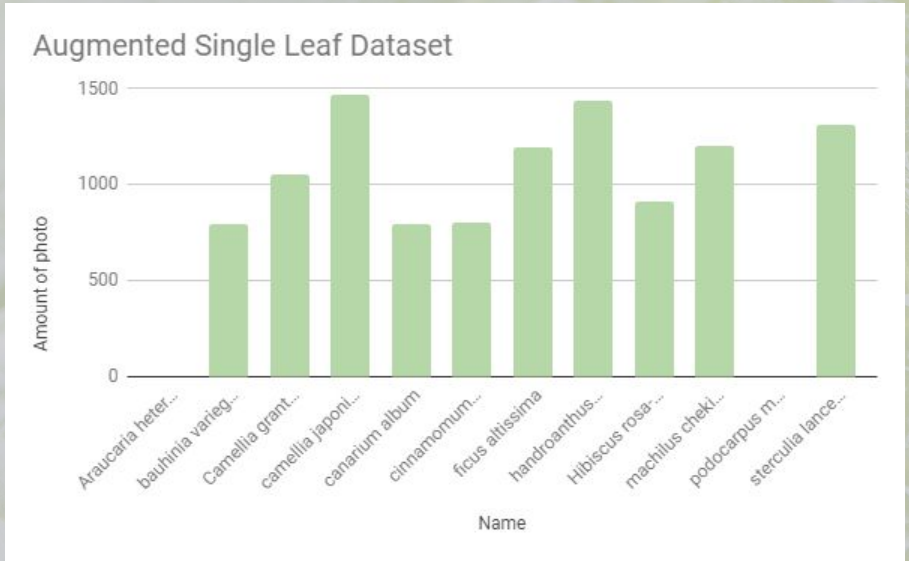

ca02004.jpg


ca02005.jpg

Data Preparation

- Augmentation (Geometric Transformation)
  - Flipping
  - Rotation
  - Random Crop
  - Shearing

Data Preparation




mc_0_258.jpg


mc_0_277.jpg

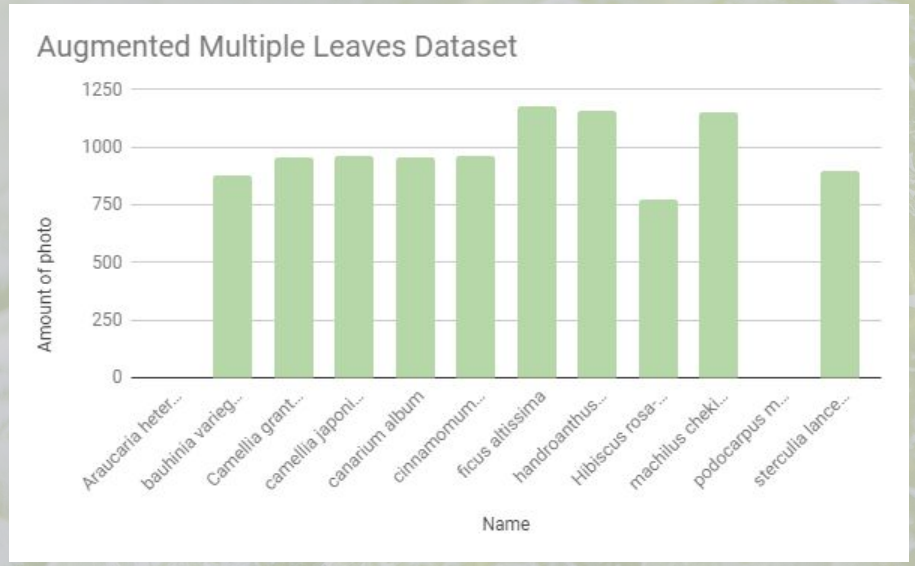

mc_0_326.jpg


mc_0_334.jpg


mc_0_390.jpg


mc_0_392.jpg

Data Preparation




fa_0_192.jpg


fa_0_196.jpg

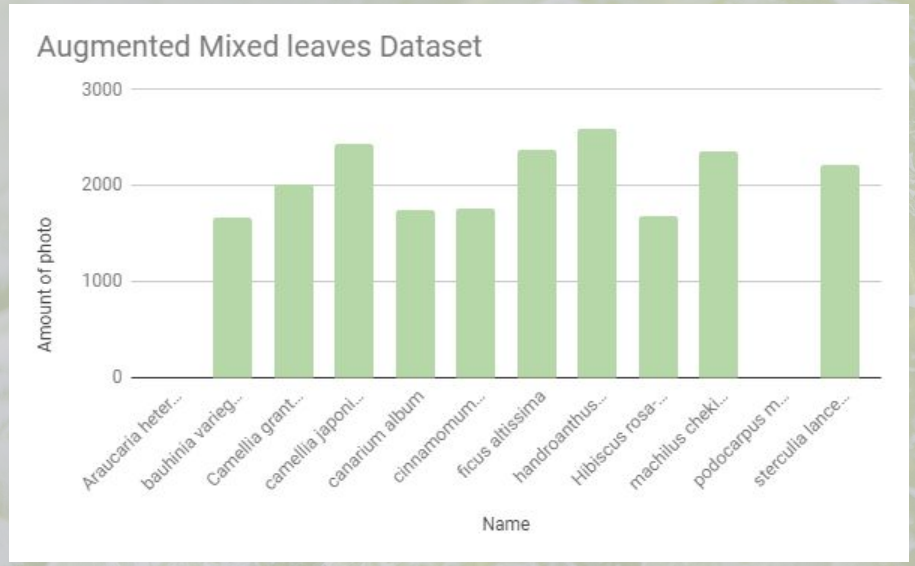

fa_0_242.jpg


fa_0_249.jpg


fa_0_326.jpg


fa_0_327.jpg

Data Preparation




ca_0_4.jpg


ca_0_5.jpg


ca_0_37.jpg


ca_0_76.jpg

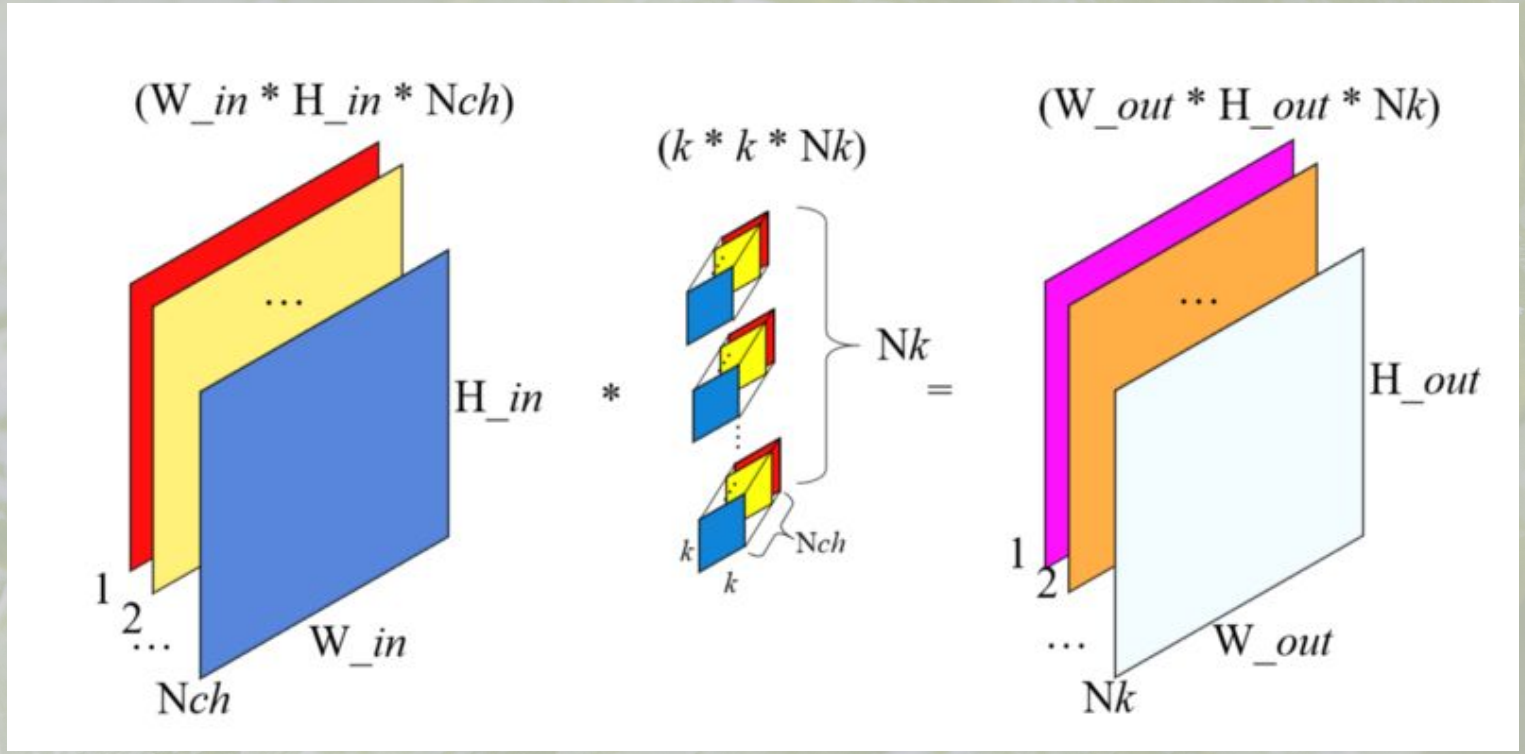

ca_0_118.jpg


ca_0_123.jpg

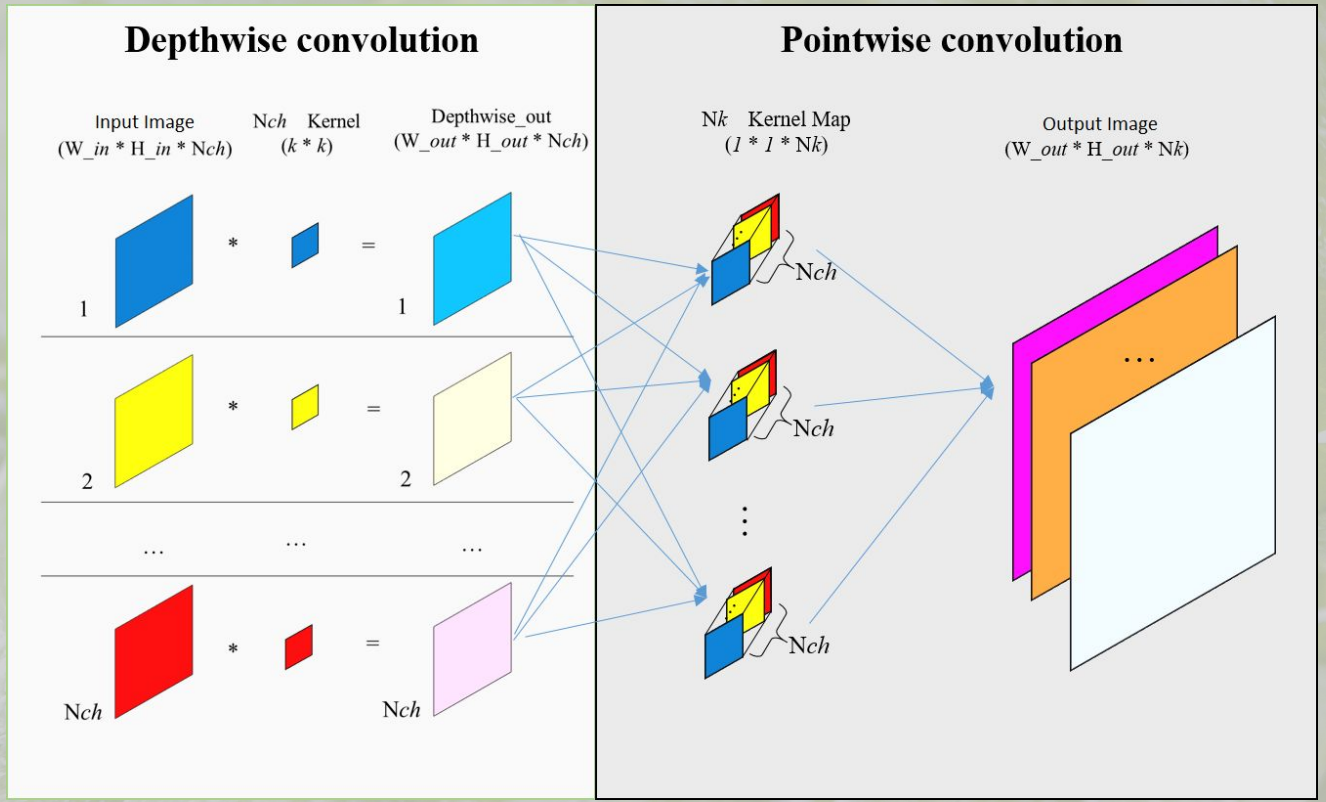
Concern

- Development Cycle
- Portability
- Speed

MobileNet


(W_in * H_in * Nch)
H_in
W_in
1
2
…
Nch
*
(k * k * Nk)
Nk
k
k
Nch
=
(W_out * H_out * Nk)
H_out
W_out
1
2
…
Nk

MobileNet

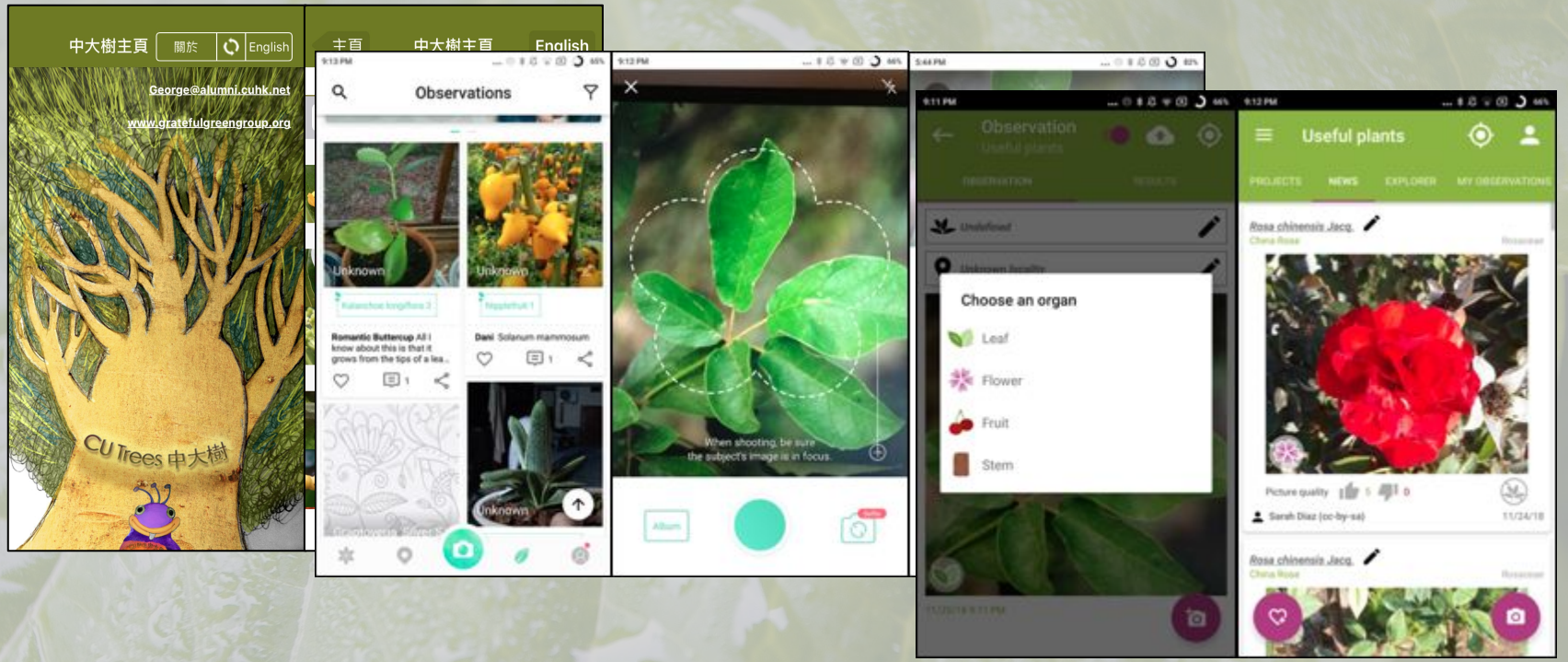

Depthwise convolution
Input Image
(W_in * H_in * Nch)
Nch Kernel
(k * k)
Depthwise_out
(W_out * H_out * Nch)
1
2
Nch
Pointwise convolution
Nk Kernel Map
(1 * 1 * Nk)
Output Image
(W_out * H_out * Nk)
Nch
Nch
Nch

Experiment

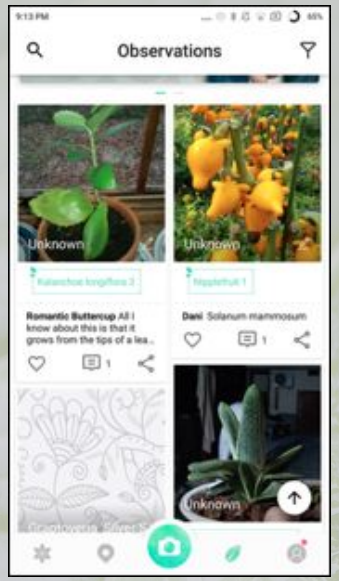
	Original	Augmented
Single Leaf	95.6%	96.8%
Multiple Leaves	97.9%	98.5%
Mixed Leaves	97.3%	97.2%

Mobile Application

Research On Current Market



Highlight 1 - Online Database



Application	Database
PlantSnap	585,000 species, with 90%[1] of accuracy
PictureThis (形色 - 拍照識花識別植物)	4,000 species, with 98% [2] of accuracy
Pl@ntNet	7657 species of plants in USA [3]

[1] Statistical data such as the size of database and accuracy of identification mentioned in official website, https://www.plantsnap.com/
[2] Statistical data such as the size of database and accuracy of identification mentioned in official website, http://www.xingseapp.com/
[3] Statistical data such as the size of database and accuracy of identification mentioned in official website, https://identify.plantnet-project.org/

Highlight 2 - Assistance of Recognition

User can choose the part showing photo

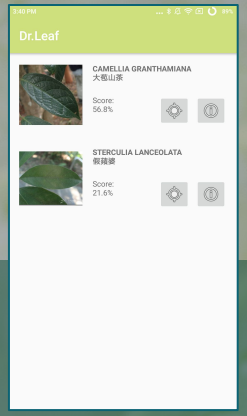
User can take photo with the focus area.

Highlight 3 - No recognition

User have to input the name and search the details of the plant.

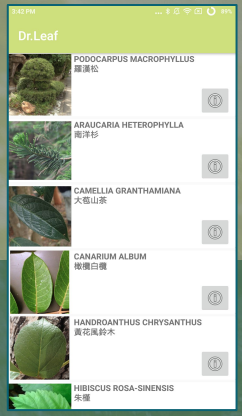
Dr.Leaf

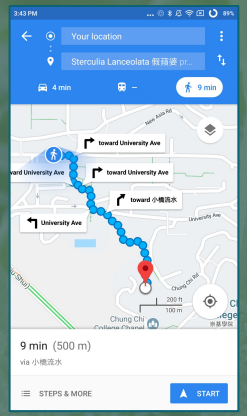

Dr.Leaf
MAP
ALL
TAKE A PHOTO
CLASSIFY


Dr.Leaf
CAMELLIA GRANTHAMIANA
大苞山茶
Score:
56.8%
STERCULIA LANCEOLATA
假蘋婆
Score:
21.6%


3:39 PM
90%
Dr.Leaf
MAP
ALL
STEP 1
Take a photo of the leaf
STEP 2
Classify it!
85%
TAKE A PHOTO
CLASSIFY


College
United College
New Asia College
Art Museum of the Chinese University of...
Chinese University of Hong Kong Parking
Sterculia Lanceola...
Chung Chi College Chapel
Lingnan Stadium
University
Google

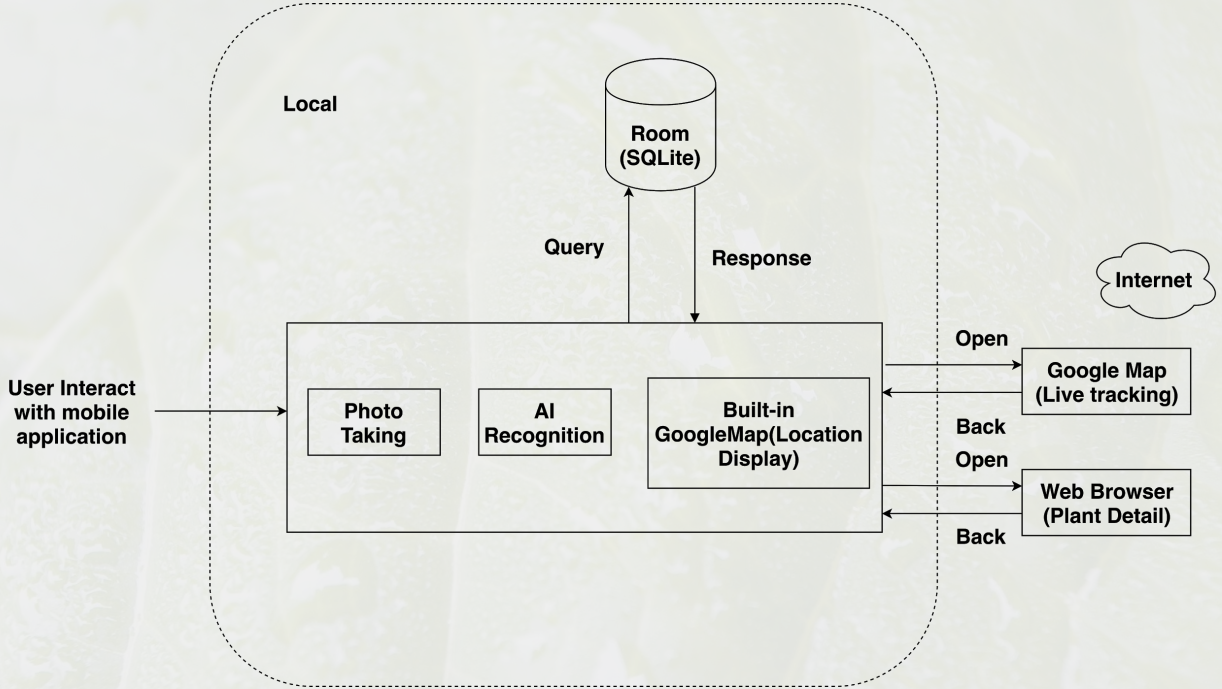

Dr.Leaf
PODOCARPUS MACROPHYLLUS
羅漢松
ARAUCARIA HETEROPHYLLA
南洋杉
CAMELLIA GRANTHAMIANA
大苞山茶
CANARIUM ALBUM
橄欖白欖
HANDROANTHUS CHRYSANTHUS
黃花風鈴木
HIBISCUS ROSA-SINENSIS
朱槿


Your location
Sterculia Lanceolata 假蘋婆 pr...
4 min
9 min
toward University Ave
toward University Ave
toward 小橋流水
University Ave
9 min (500 m)
via 小橋流水
STEPS & MORE
START


syhuherbarium.sls.cuhk.edu.hk/collecti
School of Life Sciences, The Chinese University of Hong Kong
Camelia granthamiana Sealy
大苞山茶
Home / Pro-Factsheet
/ Camelia granthamiana Sealy 大苞山茶

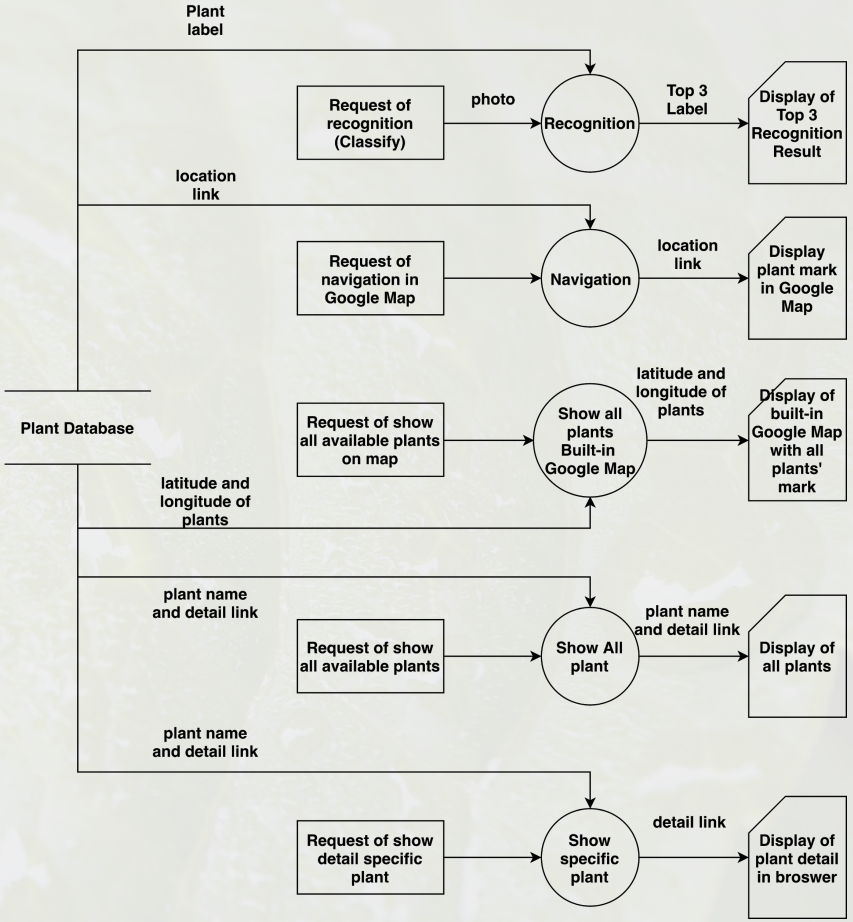
Design Specification

Architecture Design



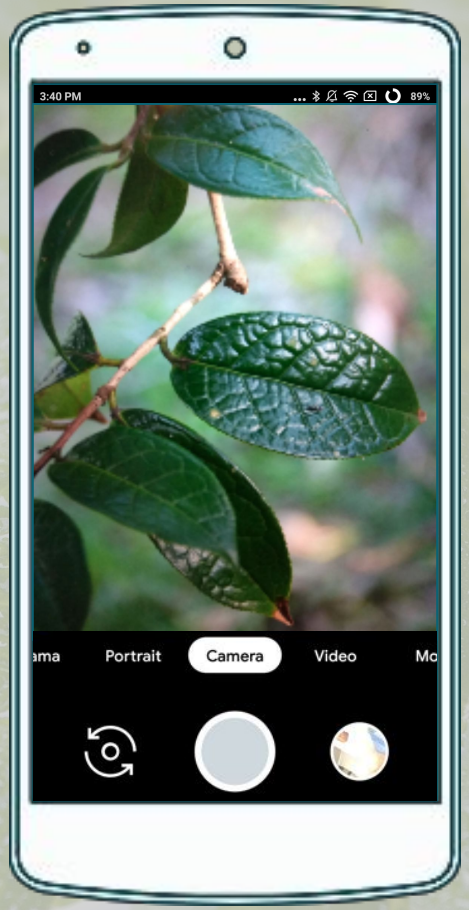
Dataflow Diagram

All functions share the same database.

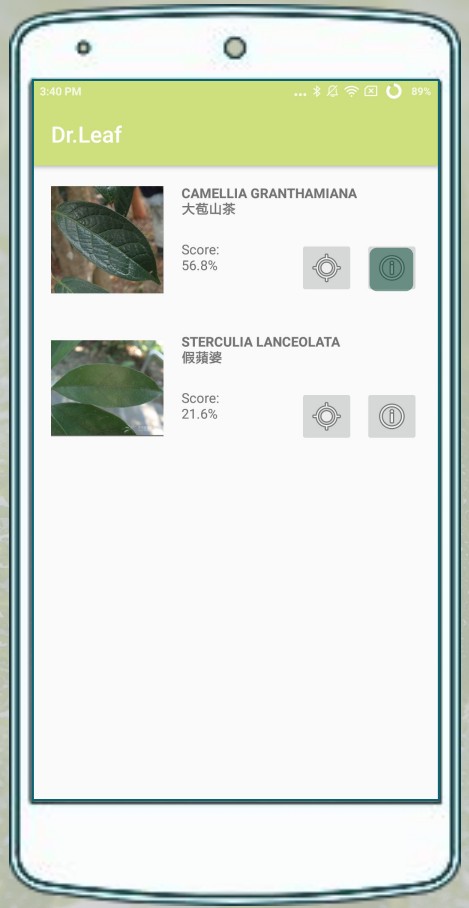


Two-Step Recognition with 97.2% accuracy

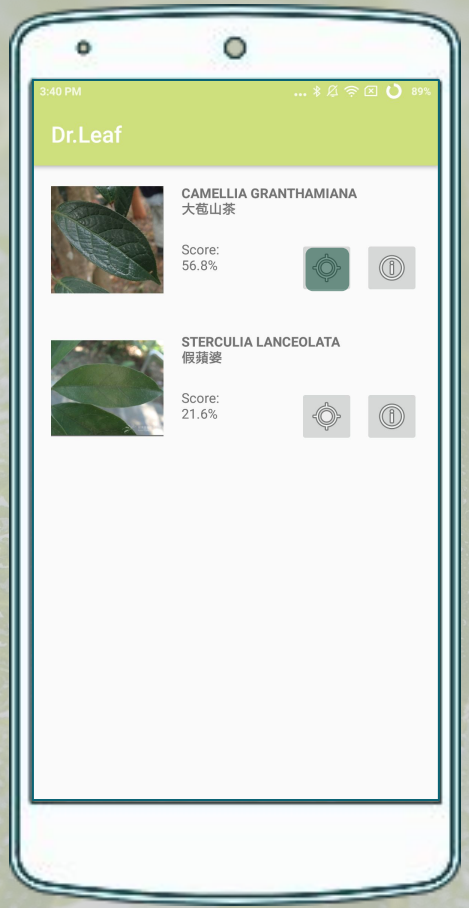

3:39 PM
90%
Dr.Leaf
MAP
ALL
STEP 1
Take a photo of the leaf
STEP 2
Classify it!
85%
TAKE A PHOTO
CLASSIFY


3:40 PM
89%
ama
Portrait
Camera
Video
Mo


3:40 PM
89%
Dr.Leaf
MAP
ALL
TAKE A PHOTO
CLASSIFY


3:40 PM
89%
Dr.Leaf
CAMELLIA GRANTHAMIANA
大苞山茶
Score:
56.8%
STERCULIA LANCEOLATA
假蘋婆
Score:
21.6%


3:40 PM
89%
syhuherbarium.sls.cuhk.edu.hk/collecti
胡秀英植物標本館
SHIU-YING HU HERBARIUM
School of Life Sciences, The Chinese University of Hong Kong
Camelia granthamiana Sealy
大苞山茶
Home / Pro-Factsheet
/ Camelia granthamiana Sealy 大苞山茶


3:40 PM
89%
Dr.Leaf
CAMELLIA GRANTHAMIANA
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Score:
56.8%
STERCULIA LANCEOLATA
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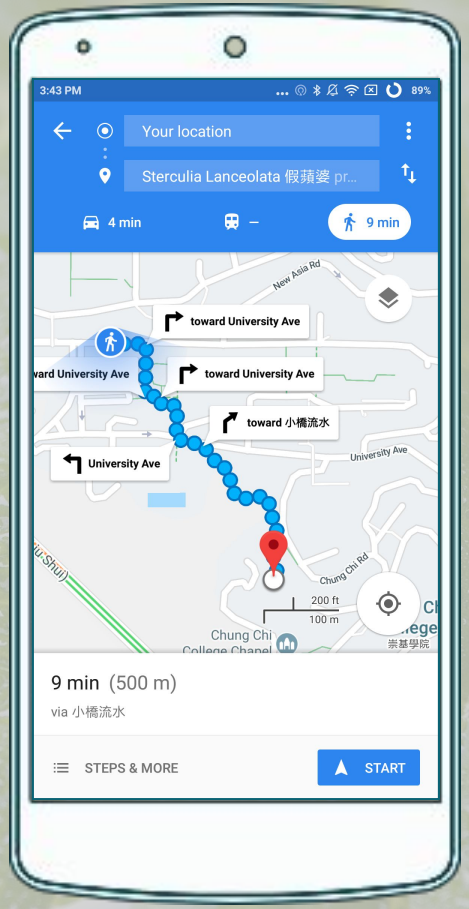
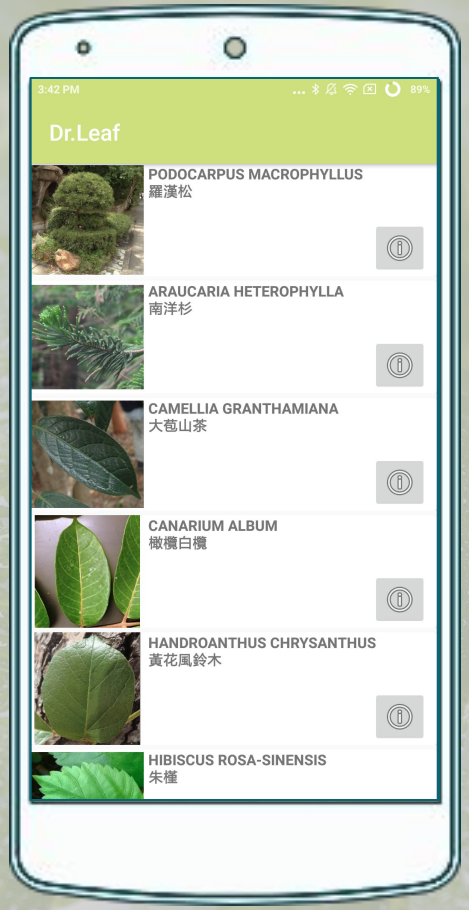
Score:
21.6%


3:43 PM
89%
Your location
Sterculia Lanceolata 假蘋婆 pr...
4 min
–
9 min
New Asia Rd
toward University Ave
toward University Ave
toward 小橋流水
University Ave
University Ave
Chung Chi Rd
200 ft
100 m
Chung Chi College Chapel
崇基學院
9 min (500 m)
via 小橋流水
STEPS & MORE
START

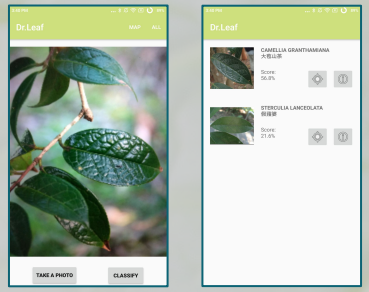
Look up all the plants in map


3:42 PM
89%
College
和聲書院
United College
聯合書院
New Asia
College
新亞書院
United Rd
Art Museum of the
Chinese University of...
香港中文大學文物館
Chinese University of
Hong Kong Parking
香港中文大學停車場
Sterculia Lanceola...
Nursery Path
Chung Chi
College Chapel
崇基學院禮拜堂
Lingnan Stadium
嶺南體育館
Station Rd
University
大學
Google

Look up all the plants in list

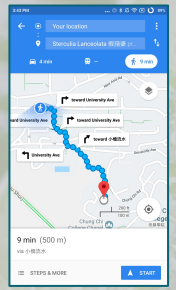

3:42 PM
89%
Dr.Leaf
PODOCARPUS MACROPHYLLUS
羅漢松
ARAUCARIA HETEROPHYLLA
南洋杉
CAMELLIA GRANTHAMIANA
大苞山茶
CANARIUM ALBUM
橄欖白欖
HANDROANTHUS CHRYSANTHUS
黃花風鈴木
HIBISCUS ROSA-SINENSIS
朱槿

Functionality



Recognition

Look up plants in CUHK



Navigation

Check out plants detail

Evaluation

User Interface

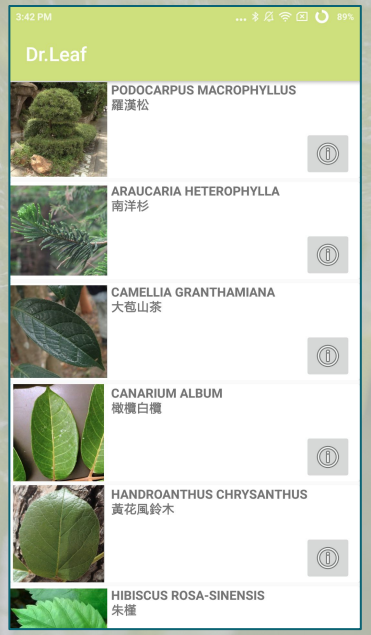
Rely on WIMP(Windows, Icons, Menus and Pointing Device)

Pros:

- Flow is clear
- Easy to follow

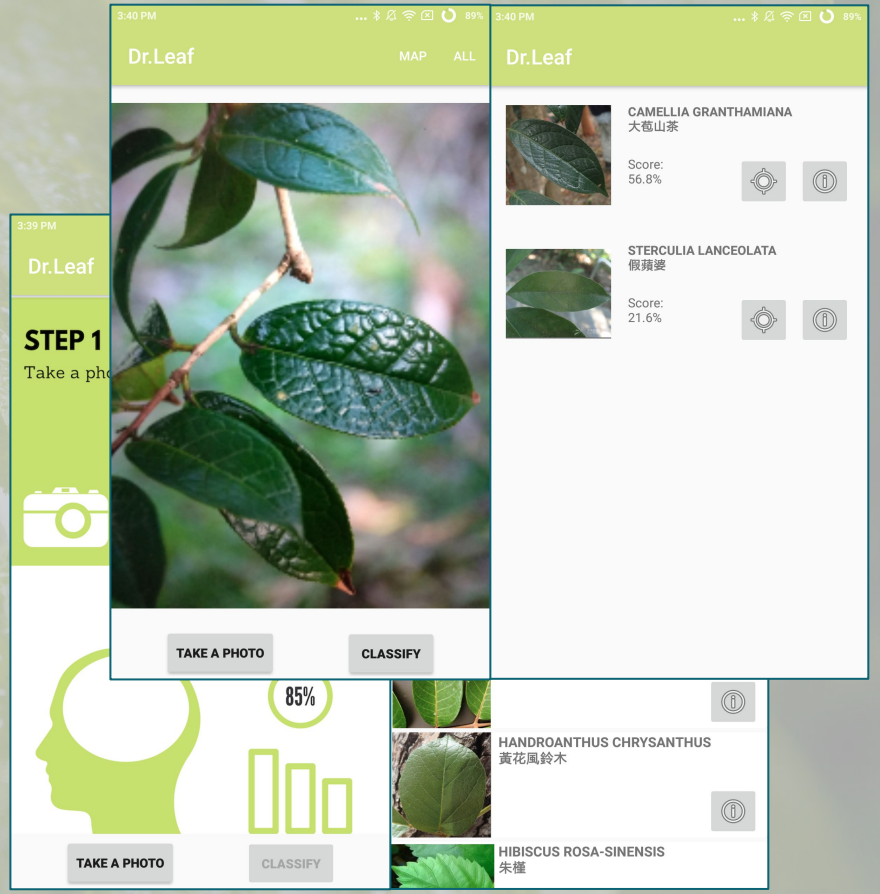
Cons:

- Old style
- Not attractive



Testing - Functional

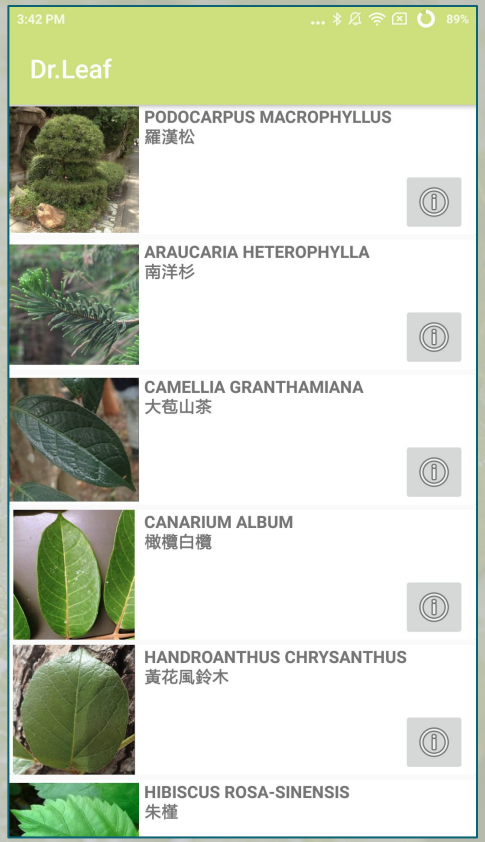
Function	Result
Open camera	Pass
Recognition	Pass
Website button	Pass
Location button	Pass



Testing - UI

Only testing in emulator is not enough.

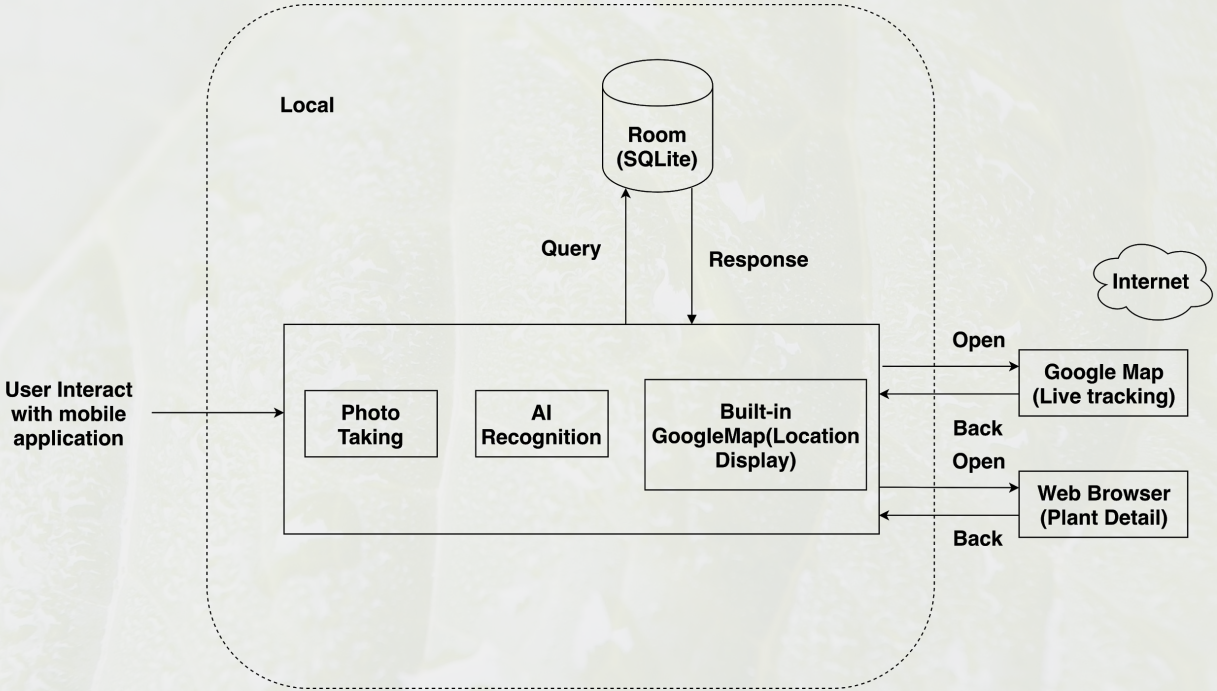
Momery resource problem.



Evolvability

- Modularity
- Keep database record
- GitLab version control
- Resrouce file system in android studio

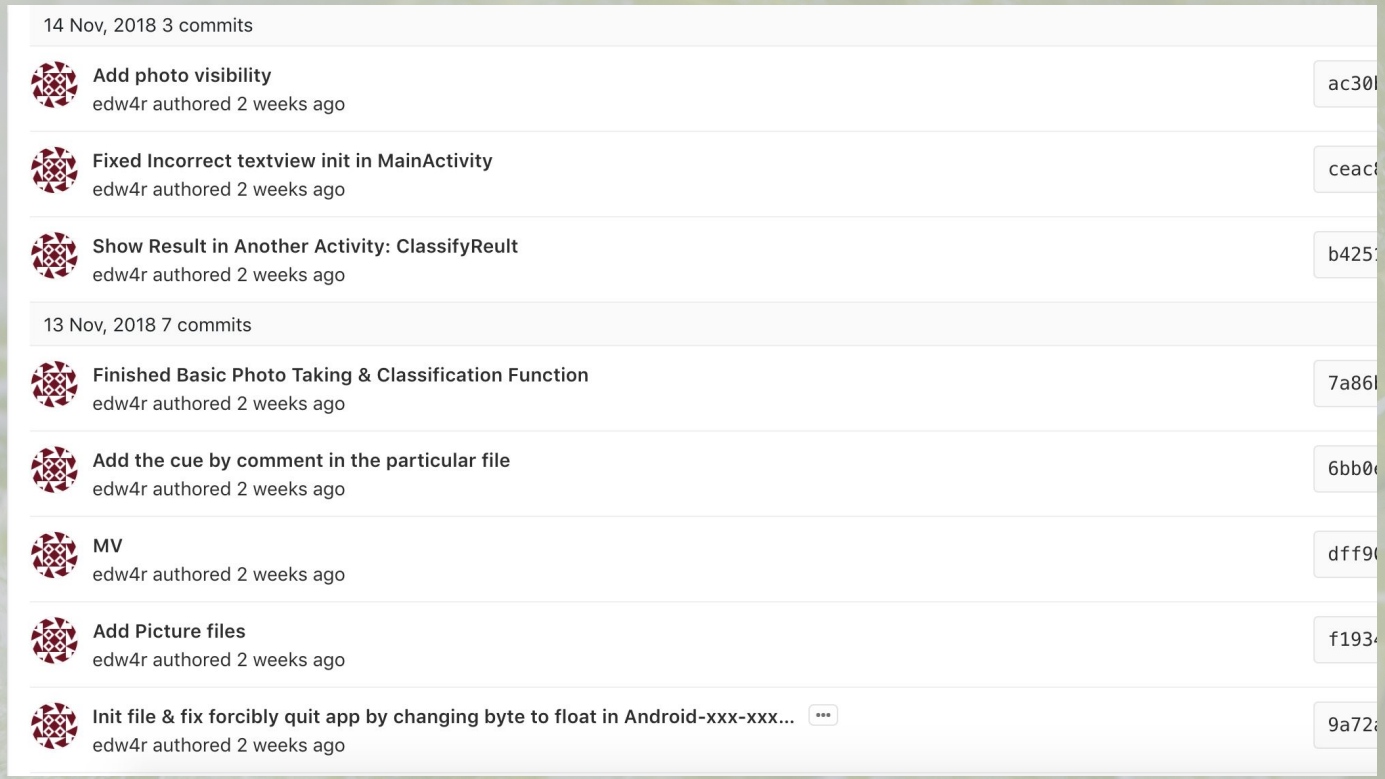
Evolvability - Modularity



Evolvability - Keep database record

```
{
  "formatVersion": 1,
  "database": {
    "version": 3,
    "identityHash": "ff414d2037da9108e2fa40b6be767a95",
    "entities": [
      {
        "tableName": "plant_table",
        "createSql": "CREATE TABLE IF NOT EXISTS `${TABLE_NAME}` (`code` TEXT NOT NULL, `na
        "fields": [
          {
            "fieldPath": "plantCode",
            "columnName": "code",
            "affinity": "TEXT",
            "notNull": true
          },
          {
            "fieldPath": "nameEng",
            "columnName": "nameEng",
            "affinity": "TEXT",
            "notNull": false
          },
          {
            "fieldPath": "nameChi",
            "columnName": "nameChi",
```

Evolvability - Gitlab Version Control



Evolvability - Resource Control

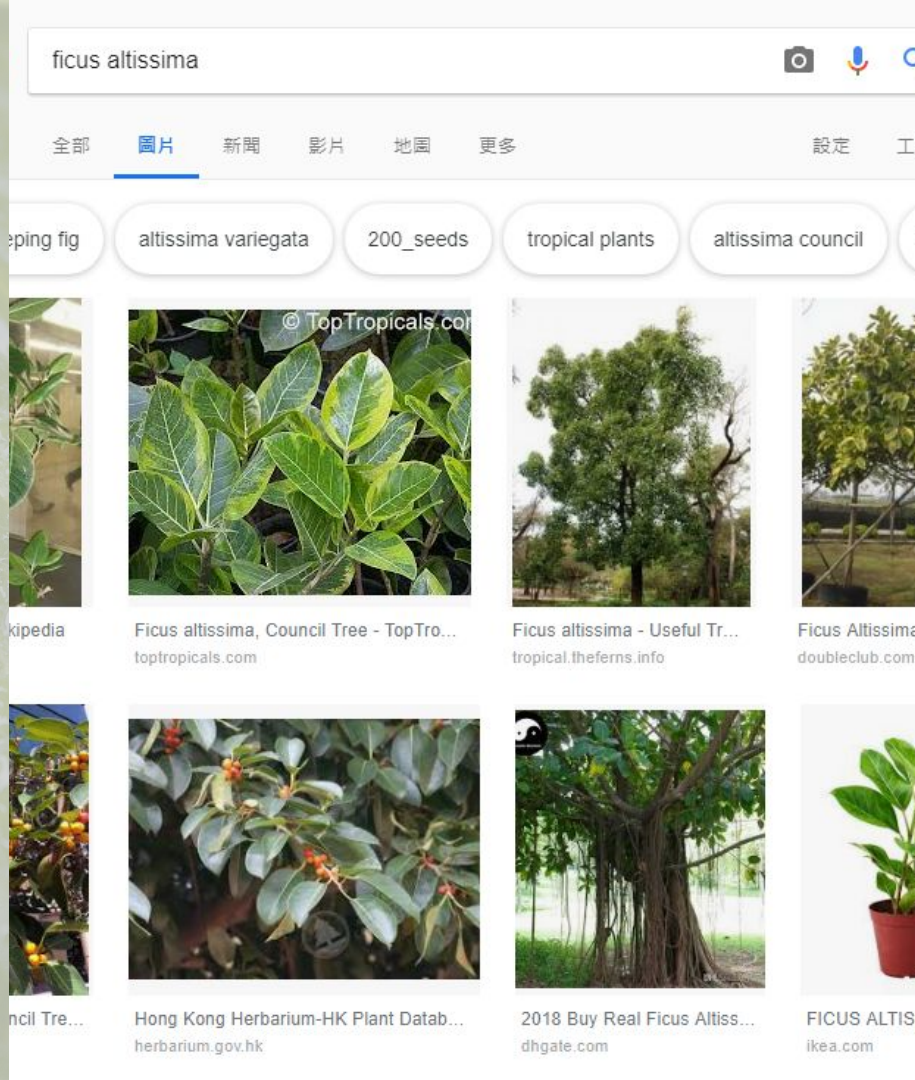
all_leaves.java | PlantDao.java | strings.xml | colors.xml | PlantsMapsActivity.java

Edit translations for all locales in the translations editor.

```
1  <resources>
2      <string name="app_name">Dr.Leaf</string>
3      <string name="title_activity_specific_plant_result">SpecificPlantResult</string>
4      <string name="action_settings">Settings</string>
5      <string name="title_activity_room_testing">roomTesting</string>
6      <string name="title_activity_plants_maps">Map</string>
7  </resources>
8
```

Limitation and Difficulties

- No exsisting tree database
- web-crawling is not realistic



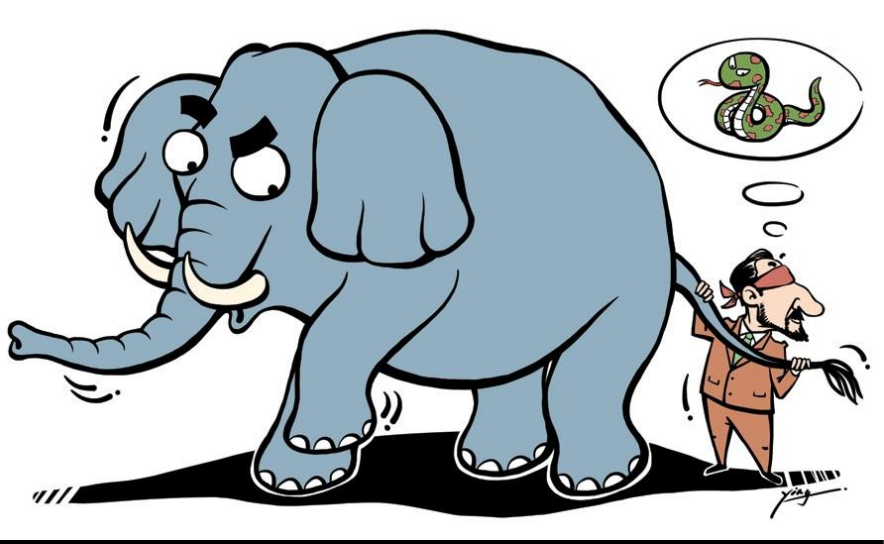
Limitation and Difficulties

- Only leaf is not enough
- Tree features varies in different habitats

Future Development

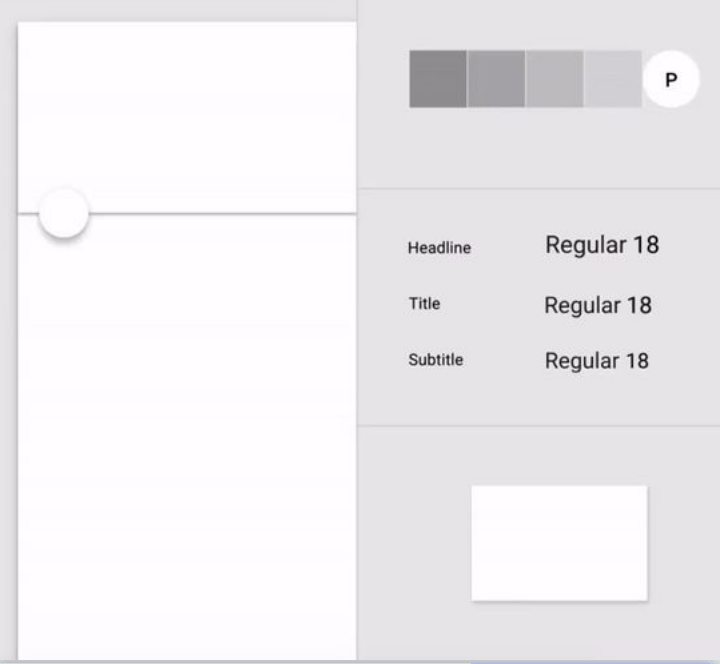
AI Model

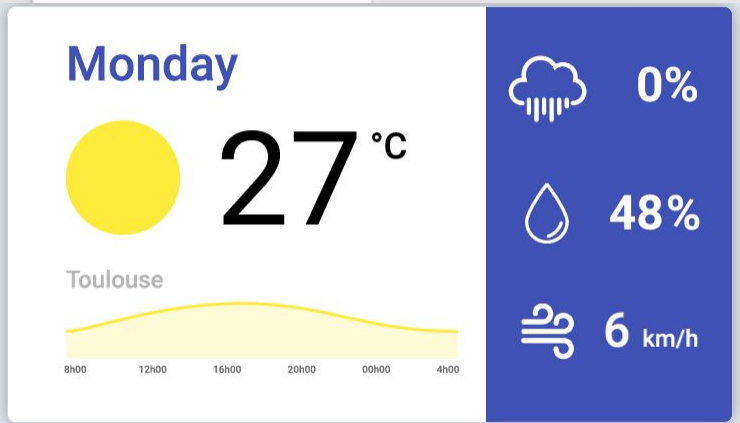
- More features
- More Species



Mobile app

- Add more function
- Imporove UI/UX
- More testing





[1] Pircure is retrieved from https://material.io/
[2] Pircure is retrieved from https://giphy.com/gifs/weather-11youGHnnqd8yc/links


Thank You

Q & A