# HGO-CNN: Hybrid Generic-Organ Convolutional Neural Network For Multi-Organ Plant Classification

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## Introduction

- Botanists classify plant species by observing plant organs such as stem, flower, branch, fruit and leaf.
- Large variability in the appearance of plant organs makes multi-organ plant identification a challenging task.

## Motivation

- Previous works based on generic features [1,2] might not be able to provide an appropriate description for a plant. This is because generic network learns irrelevant features, especially when they appear to be discriminative among species.

## Objective

- We propose an end-to-end train hybrid generic-organ convolutional neural network (**HGO-CNN**).
- The HGO-CNN extracts prior organ information, and, classifies plant images based on the correlation between organ and generic-based features.

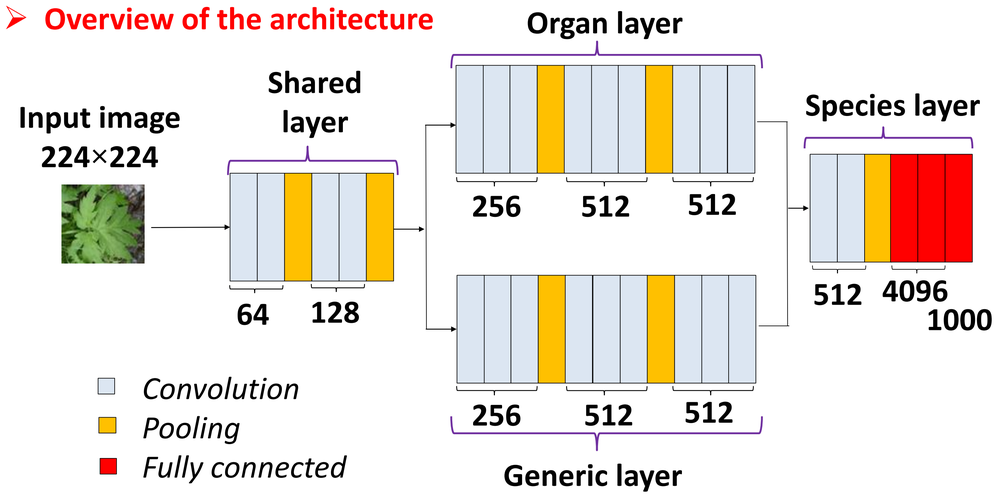
## Performance Comparisons

Note that, BD = borda count and MAV = majority voting.

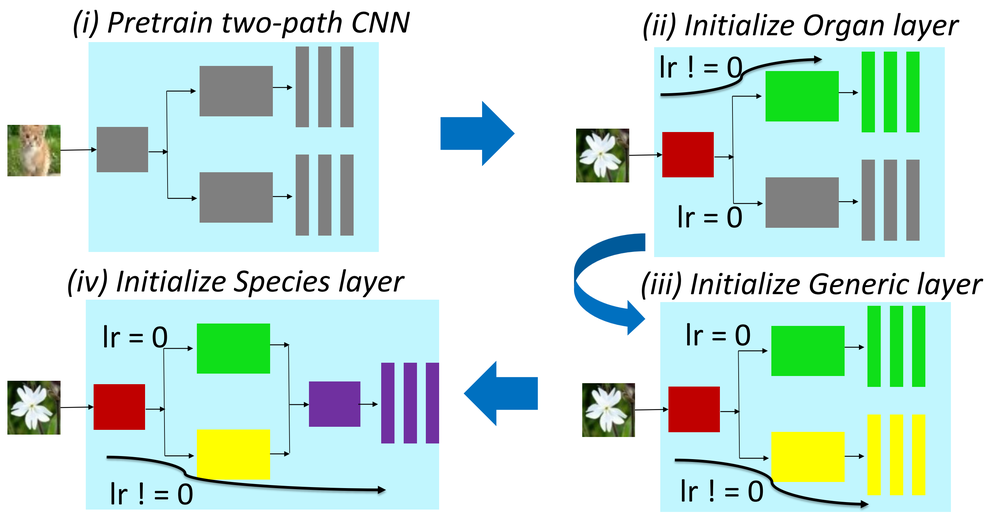
| Method | $S_{obs}$ | $S_{img}$ |
|---|---|---|
| GoogLeNet (MAV) [2] | 0.609 | 0.581 |
| GoogLeNet (content + domain) [3] | 0.633 | - |
| GoogLeNet + softmax normalization [3] | 0.624 | 0.590 |
| 5-fold GoogLeNet (MAV) [1] | 0.667 | 0.652 |
| HGO-CNN (MAV) | 0.671 | 0.647 |
| HGO-CNN (BD) | 0.673 | 0.647 |
| M-S HGO-CNN (MAV) | 0.715 | 0.690 |
| **M-S HGO-CNN (BD)** | **0.717** | **0.690** |

## HGO-CNN

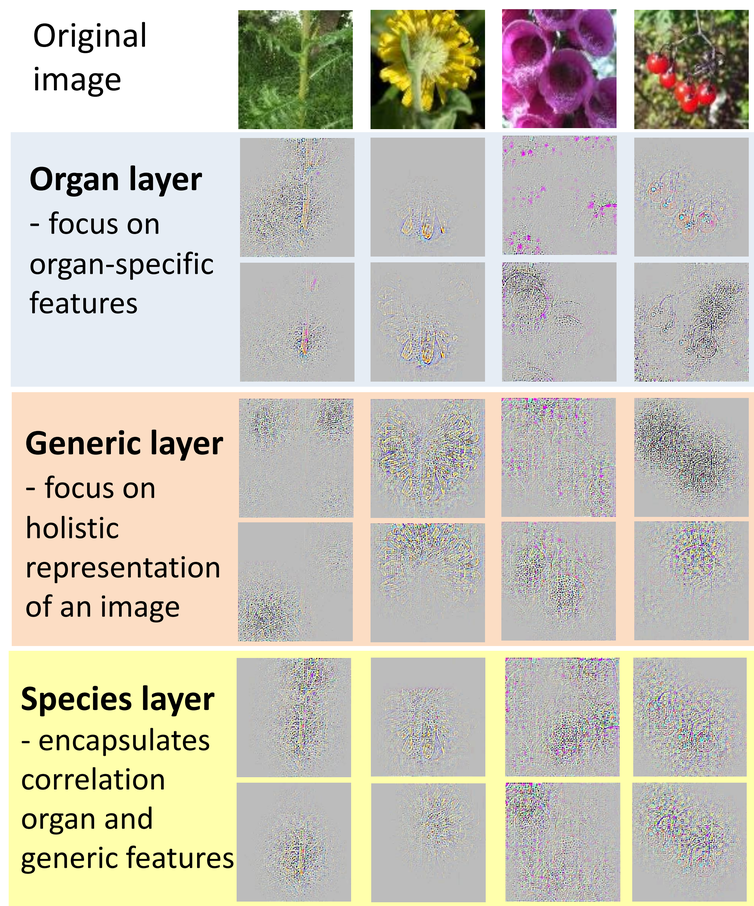
➢ **Overview of the architecture**




➢ **Feature Fusion training scheme**




## Qualitative Results




## Example of Failure case


## Conclusion

- Features learned from HGO-CNN model outperforms ($S_{obs}$ = 0.717 %) state-of-the-art methods.
- Moreover, it is worth noting that multi-scale training can further boost up the model performance.

## References

In working notes of Clef2015 Conference, 2015:
[1] Plant identification with deep convolutional neural network: Snumedinfo at lifeclef plant identification task 2015
[2] A comparative study of fine-grained classification methods in the context of the lifeclef plant identification challenge 2015
[3] Content specific feature learning for fine-grained plant classification