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Evaluation-4

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Problem Statement And Motivation

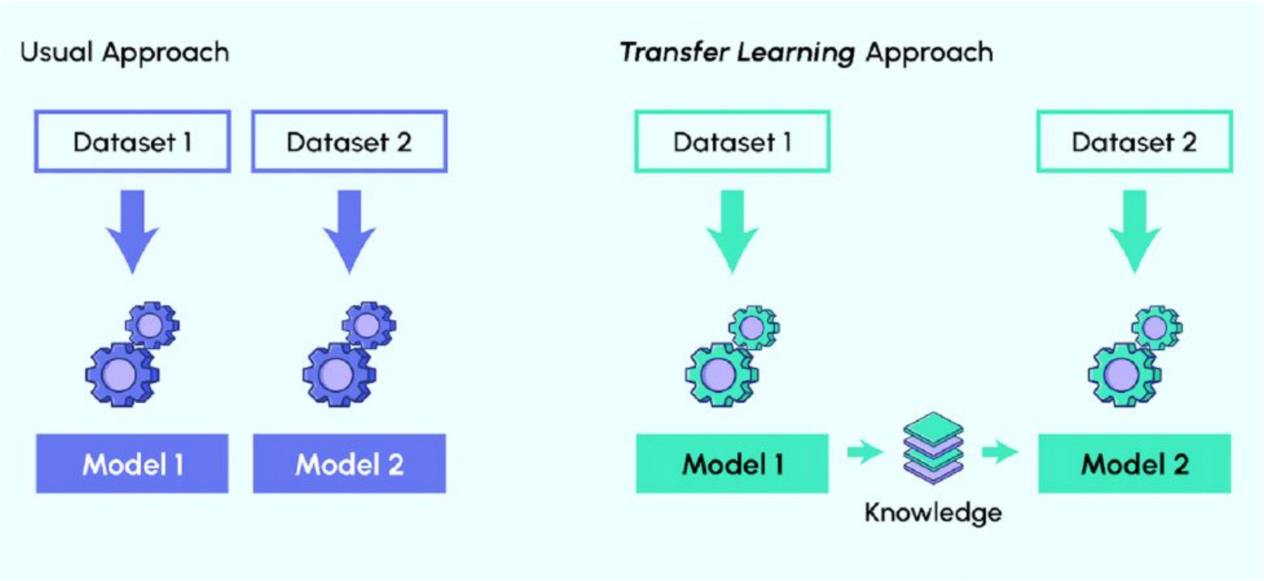
Problem Statement : **Propose A Novel Deep Learning Framework Using Transfer Learning And GAN's To Improve The Results Of Existing Approaches In Precision Agriculture.**

Motivation: **Existing precision agriculture methods struggle to adapt to varying environmental conditions and evolving crop diseases, leading to reduced accuracy and reliability.**

How Transfer Learning and GANs Address the Disadvantage?

We don’t have to reinvent the wheel!

The ability of system to recognize and apply knowledge and skills in previous tasks to novel tasks, which share some commonality.



Introduction

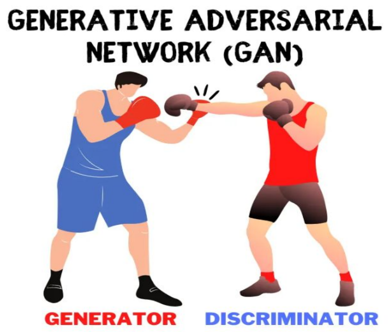
Convolution: Commonly used in deep learning for **feature extraction** from images . It involves **sliding a filter** or kernel **over the input data** to capture local patterns.

Pretrained Model : It is a neural network that has been trained on a **large dataset** and saved.It can be used as a starting point for solving other machine learning tasks or fine-tuned on a smaller dataset.

Zero shot learning : It is a specific type of transfer learning where a model is trained to recognize and classify objects or concepts it has never seen during its training phase by generalizing knowledge from **seen to unseen classes**.

Generative Adversarial Networks

GAN is an unsupervised deep learning algorithm where we have a **Generator** pitted against an have a adversarial network called **Discriminator**.



StyleGAN is a generative model that excels in generating **high-quality images** with control over various aspects of style, including features such as facial expressions, hairstyles, and more.

Zero Shot Learning

Zero- and few-shot learning for diseases recognition of Citrus aurantium L. using conditional adversarial **autoencoders**

Model achieved a harmonic mean accuracy of **53.4%** for zero-shot recognition of Citrus aurantium L. diseases

Difference between zero-shot learning and few-shot learning?

Zero-shot learning involves recognizing objects or concepts **without prior** training examples, while few-shot learning utilizes a small number of examples to recognize new objects or concepts.

Previous Work

Transfer Learning using Convolution Model

We conducted convolutional training on tomato classes and achieved an accuracy of 82%. However, when applying the saved weights from the tomato classes to test on potato classes, the accuracy dropped to 40%.

Implementation of GANs: We have generated **synthetic images** of leaves using GANs, Style GAN

Datasets considered: Plant Village, Plant Doc Dataset

Plant Village

Plant Doc

We have used different pretrained models and performed transfer learning on different combinations of classes.

Source Code

Tomato(Plant Village) → **Tomato(Plant Village) – Accuracy – 89%**

Vgg-19

Tomato(Plant Village) → **Potato(Plant Village) – Accuracy – 72%**

Tomato(Plant Village) → **Potato(Plant Doc) – Accuracy – 62%**

Augmented Tomato(Plant Village) → **Potato(Plant Doc) – Accuracy – 68%**

Segmented Tomato(Plant Village) → **Potato(Plant Doc) – Accuracy – 71%**

Problems and Solutions

1. **Data imbalancing using style GAN, DCGAN**
2. **Augmentation Techniques:** Image Rotation, Scaling, Translation, Brightness.
3. **Segmentation Techniques:** Ostu Thresholding, K-Means Clustering
4. **Hyperparameter Tuning :** Optimizer, Learning Rate, Batch size

Conclusion: By using pretrained models transfer learning inherit knowledge from vast dataset which improves accuracy and adaptability.

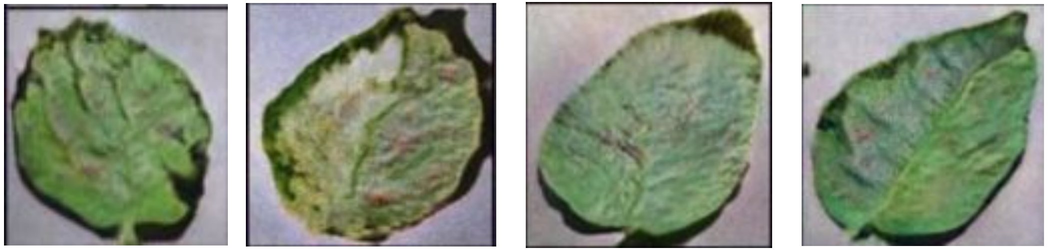
GANs enable the generation of synthetic data that closely resembles real-world agricultural conditions.

Novelty for Second Evaluation: DCGAN, Structural Similarity Index, k-means Clustering.

Deep Convolutional GAN

DCGAN is a type of GAN that uses deep convolutional networks as the generator and discriminator.

It introduced the use of convolutional layers instead of fully connected layers, which proved to be more effective in generating realistic images.



Images generated using dcgan

DCGAN excels at capturing overall patterns and structures in images.

From tomato to potato class we obtained an accuracy of 72% vice versa we got 67%

This problem is due to class imbalancing therefore we tried to include more images using styleGan, DCGAN and performed structural similarity index to find the set if images that closely resemble to our training dataset(Potato classes)

After adding the curated GAN images to the imbalance classes and tested on Tomato classes(Plant Village) dataset we obtained 66% accuracy, when tested on plant doc its 63% after adding segmentation and augmentation it increased to 67%

Segmentation

Segmentation Techniques: Otsu's thresholding extracts the largest connected component (presumed to be the leaf) from the binary mask, crops it, and resizes it.

This method is effective but might struggle with complex backgrounds or overlapping leaves.(First Evaluation)

K-Means Clustering:

K-Means clustering groups pixels based on color similarity. It's an unsupervised algorithm that can be effective when the number of clusters is known.

In plant disease identification, K-Means can help separate healthy and infected areas based on color differences.

Datasets considered: Plant Village, Plant Doc Dataset

Plant Village

Plant Doc

We have used different pretrained models and performed transfer learning on different combinations of classes.

Source Code

Vgg-19

Potato(Plant Village) → Potato(Plant Village) – Accuracy – 81%

Potato(Plant Village) → Tomato(Plant Village) – Accuracy – 67%

Potato(Plant Village) → Tomato(Plant Doc) – Accuracy – 63%

Augmented Potato(Plant Village) → Tomato(Plant Doc) – Accuracy – 65%

Segmented Potato(Plant Village) → Tomato(Plant Doc) – Accuracy – 67%

References

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- Generative Adversarial Nets.
- Augmenting Crop Detection for Precision Agriculture with Deep Visual Transfer Learning—A Case Study of Bale Detection.
- Transfer learning for Multi-Crop Disease Detection using VGG
- Plant Diseases Detection and Classification using Machine Learning Models
- Plant Diseases Recognition Using Machine Learning
- Plant Disease Detection using Deep Learning
- Tomato Leaf Diseases Classification Based on Leaf Images: A Comparison between Classical Machine Learning and Deep Learning Methods
- A Combination of Transfer Learning and Deep Learning for Medicinal Plant Classification

Thank You