# Citrus Plant Disease Identification using Deep Learning with Multiple Transfer Learning Approaches

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# Introduction

- Agricultural sector holds a vital role in the Pakistan economy by contributing 19.8% in Pakistan's total GDP. [1]
- Citrus plants covers 33% total fruit production of Pakistan.
- These production can be affected by different diseases.
- Misidentification of leaf disease in the agricultural crop can lead to improper or misuse of insecticides and pesticides , causing loss of the crop, increase in pathogen resistance and environmental effect.
- Machine learning technique has been used to tackle this problem.

[1] Memon NA, KASBIT D. Citrus fruit (Kino): Punjab produced 98% of production. Exclusive on Kino. 2017:29 - 31

# Literature Review

| Author | No of Classes | Classifier | Accuracy |
|---|---|---|---|
| Deng, 2016 | 2 | SVM | 91.93% |
| Sharif, 2018 | 5 | SVM | 90.4 % |
| Vladimir, 2019 | 3 | Voting | 93.33% |
| Doh, 2019 | 5 | SVM | 93.12 % |
| Singh, 2020 | 4 | LDA | 84.3 % |

Process followed in above literature papers.

- pre-processing,
- segmentation,
- feature extraction such as color histogram, texture, geometric, statistical features
- feature selection
- and then classification

# Motivation

- The previous studies use machine learning which require manual feature extraction and selection to achieve better result.
- Machine learning require less data as compared to deep learning.
- The proposed approach used deep learning  convolution neural network for classification of diseases in citrus leaves.

# Methodology

- Dataset

| Disease | Number of images |
|---|---|
| Black Spot | 171 |
| Canker | 163 |
| Greening | 204 |
| Melanose | 13 |
| Healthy | 58 |
| Total Images | 609 |

Healthy

Greening

Canker

Melanose

Black Spot

- External Dataset
  - Different images of pepper, potato , tomato leaves diseases

# Methodology

- Architecture : DenseNet 121
- Image size: 224x224
- Augmentation:
  - **Flipping** Images are flipped vertically and horizontally.
  - **Rotation** Images are rotated randomly from 0 to 360 degree.
  - **Shifting** Image pixels are shifted 20% width wise and height wise.
  - **Brightness** Images are brightened 50% and darkened 50%.
  - **Zoom** Images are zoomed 10%.

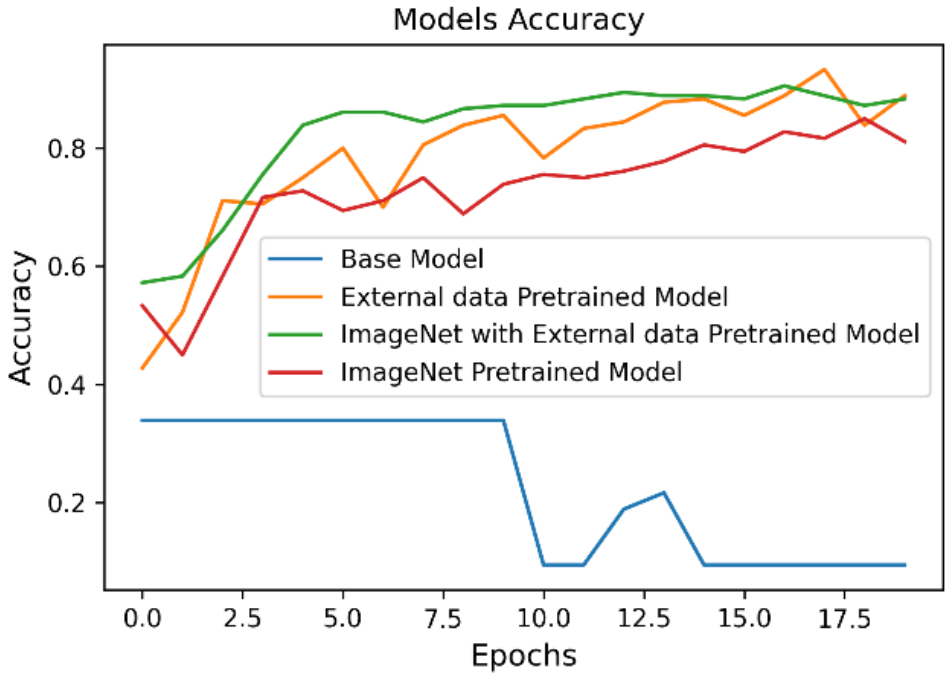
# Methodology

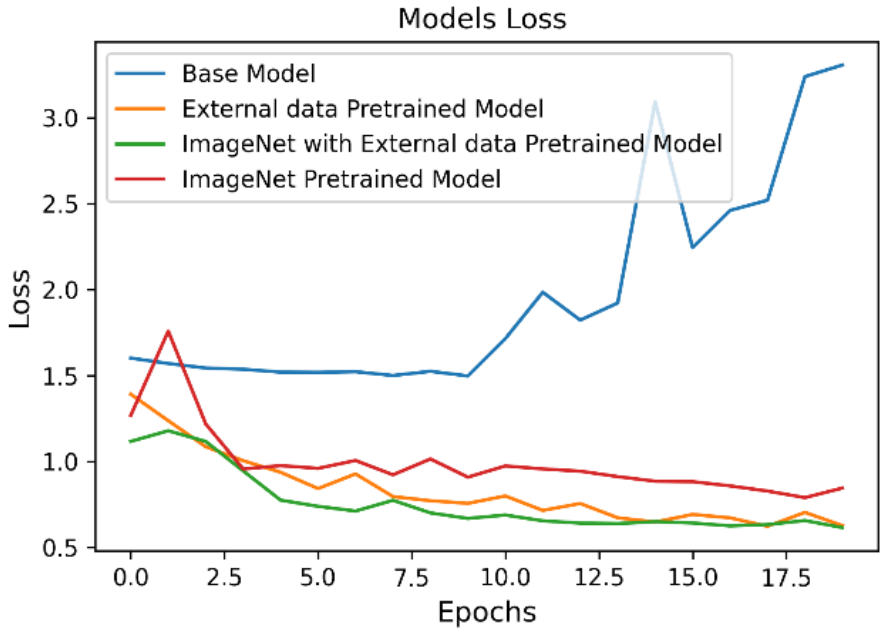
- Models
  - Randomly initialized weights base model (BM)
  - ImageNet pretrained weights (IMP)
  - External data pretrained weights model (EPM)
  - ImageNet + external data pretrained weights (IEPM)

# Results

Model Performance

| Models | Precision | Recall | F1-score | Accuracy |
|---|---|---|---|---|
| BM | 0.02 | 0.20 | 0.03 | 0.09 |
| EPM | 0.94 | 0.95 | 0.95 | 0.92 |
| IEPM | 0.92 | 0.85 | 0.88 | 0.88 |
| IPM | 0.89 | 0.86 | 0.87 | 0.82 |



# Conclusion

- Using pretrained weights, better result can be achieved. Though the pretrained models are not exactly trained on same classes dataset under study.

# Thank You

# Reference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