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TRANSFORMER HELP CNN SEE BETTER:

A LIGHTWEIGHT HYBRID APPLE DISEASE IDENTIFICATION MODEL BASED ON TRANSFORMERS

Team Name: Runtime_Terror

Apurv Prakash Shrivastava - 22MCSA02
Ayushi Tiwari - 22MCSA03
Priya Gupta - 22MCSS05

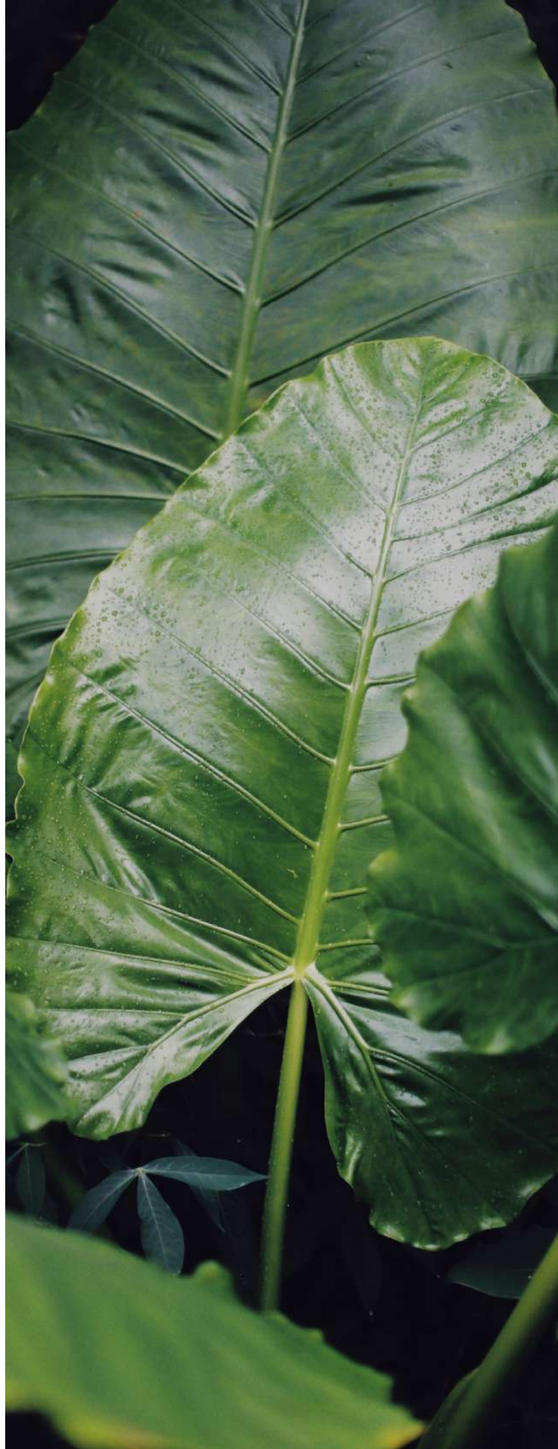
Problem

- Apple is one of the major fruit species. However, apple leaf diseases seriously affect its yield and quality.
- In the current scenario, we have a number of models that can detect apple leaf disease. They all work fine with homogeneous backgrounds but, it was ineffective in practical application scenarios such as complex backgrounds.

Case Study

- **Machine Learning:** PCA, GA, SVM, KNN (Ref. 1-4)

- **Deep learning:**
  1. CNN (Ref. 5-7)
  2. Self-Attention (Ref. 8-11)
  3. Multi-Head Attention
     a) Vision Transformer (Ref. 11-17)
     b) ConvVit (Ref. 18-23)



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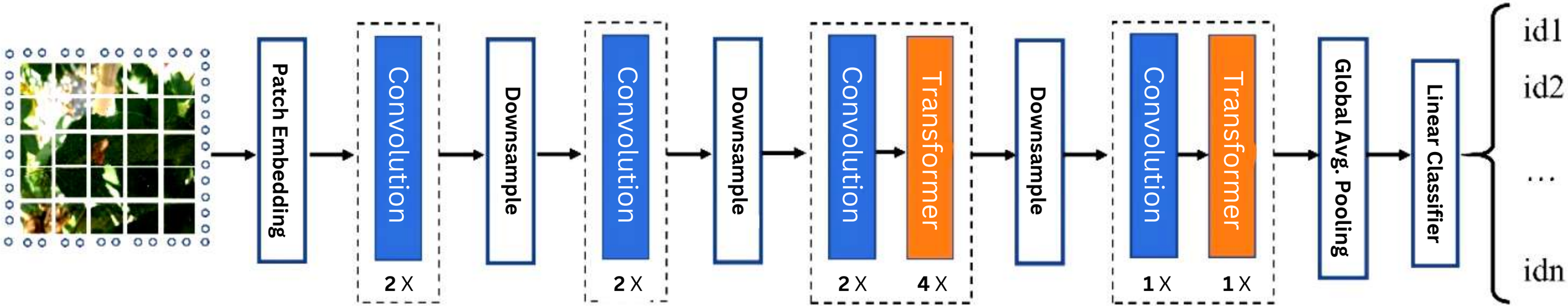
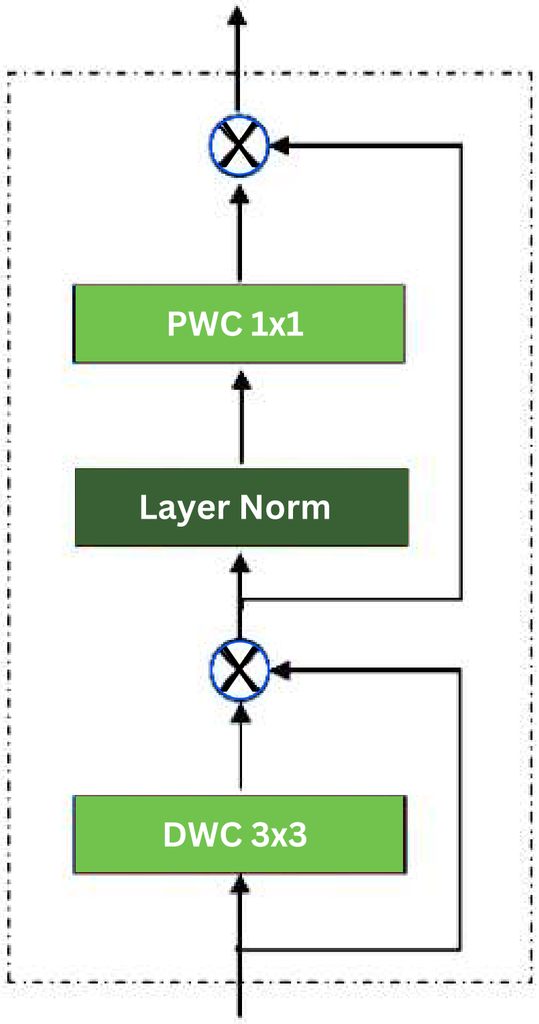
GDPR Dataset

1.	Rust	622
2.	Scab	592
3.	Multiple Disease	91
4.	Healthy	516

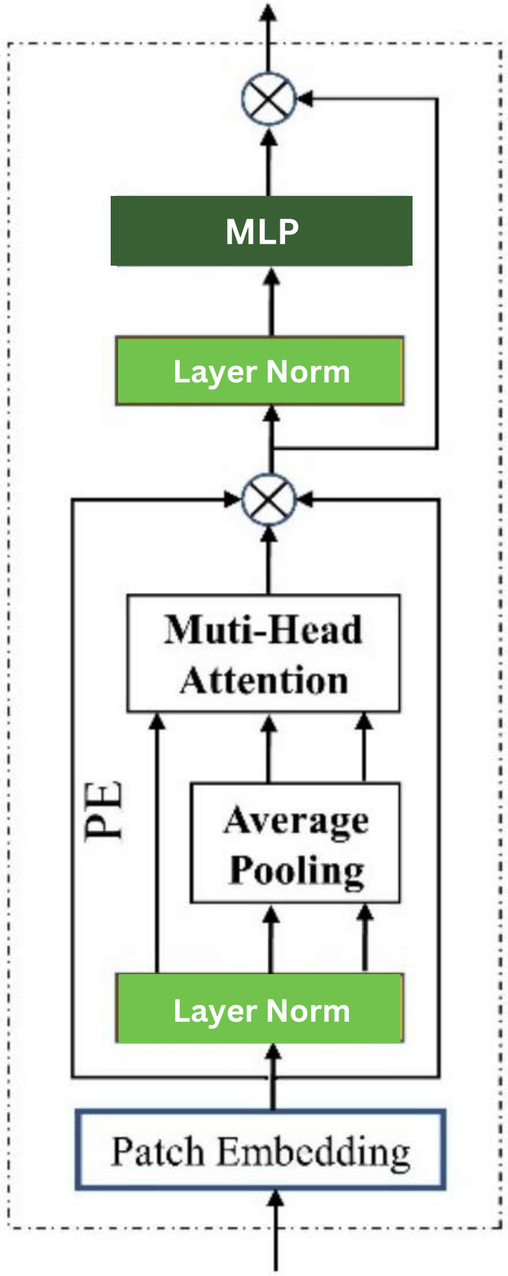
Model Overview



Convolutional
Structure



Transformer
Structure



Result Comparison

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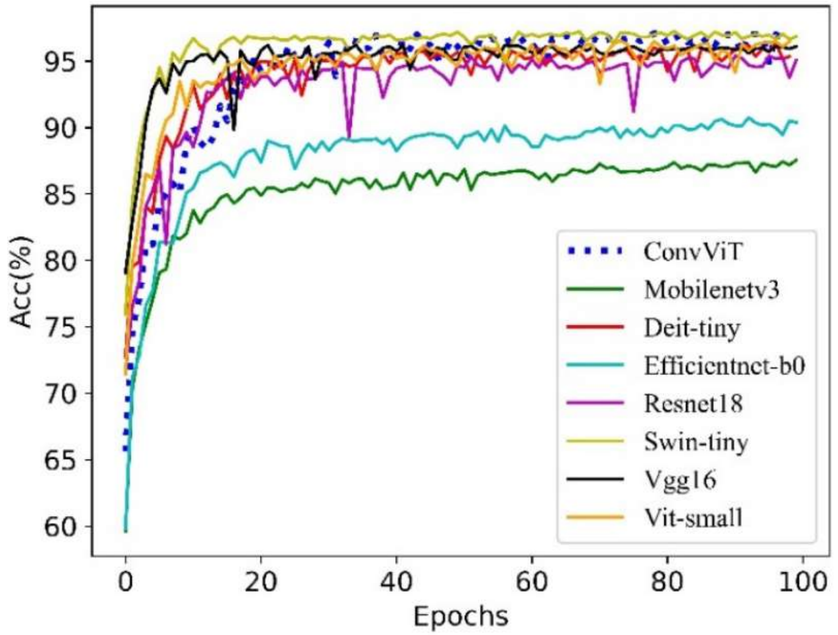
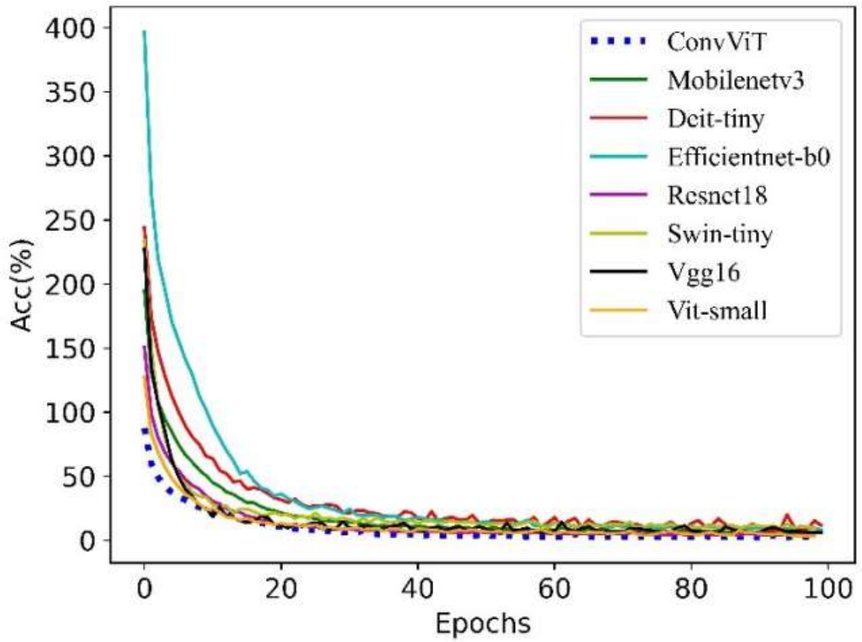
Performance Comparison



Loss Comparison



Model	Accuracy	Params	FLOPs
Vgg16	96.13%	138 M	15.5 G
Resnet18	95.19%	11.5 M	1.71 G
MobilenetV3	87.42%	5.4 M	0.22 G
Efficientnet-b0	90.44%	5.3 M	0.41 G
ViT-small	96.51%	22 M	4.24 G
DeiT-small	95.56%	5.0 M	1.3 G
Swin-tiny	96.94%	29 M	4.5 G
ConvViT (ours)	96.85%	9.5 M	0.98 G

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Conclusion

The transformer-based CNNs model can significantly improve the the identification of apple leaf diseases in complex backgrounds.

- The model’s parameters and FLOPs are significantly reduced, enabling ConvViT to be applied to real-world scenarios.
- Compared with experimental results on other dominant network structures, the model achieves competitive recognition accuracy on a self-built apple dataset with much lower parameters and FLOPs than other models with the same performance.

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Thank You!

"The future belongs to those who believe in the beauty of their dreams."

— Eleanor Roosevelt