

# Smartphone based grape leaf disease diagnosis and remedial system assisted with explanations

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### Motivation to study plant disease

- To control economic loss and crop damage
- Difficult task due to limited resources
- Early detection is important but subtle



### Contributions

• ML-powered mobile-based diagnostic system



- Convolutional Neural networks (CNN)
- Contextual Importance and Utility (CIU) to localize the diseased areas
- IOS mobile app user interface for real time capture and classification

#### TerraSentia: Improved crop breeding system (Feb 2020)



Ji, Tianchen, et al. "Proactive Anomaly Detection for Robot Navigation With Multi-Sensor Fusion." *IEEE Robotics and Automation Letters* 7.2 (2022): 4975-4982.

### Healthy leaf and three abnormalities



Hughes, D., Salath'e, M., et al.: An open access repository of images on plant health to enable the development of mobile disease diagnostics. arXiv preprint arXiv:1511.08060 (2015)



### Plant Village dataset\*



Class	No of Images
Black rot	1180
Esca	1383
Leaf Blight	1076
Healthy	423
Total	4062

\* Plantvillage dataset. https://www.kaggle.com/emmarex/plantdisease, [Online; accessed 4-May 2022]

#### Data Augmentation



(A) Original (B) low light exposure (C) high light exposure (D) low contrast (E) high contrast (F) flip vertically (G) flip horizontally (H) low sharpness (I) high sharpness (J) rotate 90 degree

## Model training



# Performance comparison of 3 models

Models	Accuracy	Precision	Recall	F1 Score
Resnet18	0.987	0.97	0.97	0.97
MobileNetV2	0.996	0.99	0.97	0.98
Create ML	0.971	0.96	0.96	0.96



	Black Rot	Esca	Leaf Blight	Healthy
	R	lesNet1	8	
Precision.	0.9636	1	1	1
Recall	1	0.9799	1	0.9605
F1 Score	0.9814	0.9898	1	0.9798
Accuracy				0.987
	Mo	bileNet	V2	
Precision	0.9952	0.9880	1	1
Recall	0.9858	0.9959	1	1
F1 Score	0.9905	0.992	1	1
Accuracy				0.994
	C	reateM	L	
Precision	0.95	0.97	1	0.95
Recall	0.97	0.95	0.98	1
F1 Score	0.959	0.959	0.99	0.974
Accuracy			10	0.97

### Contextual Importance and utility



Knapič, S., Malhi, A., Saluja, R., & Främling, K. (2021). Explainable artificial intelligence for human decision support system in the medical domain. *Machine Learning and Knowledge Extraction*, *3*(3), 740-770.

### Screenshots of Mobile App for Diseases Detection



(a) Landing Screen

(b) Image Selection Screen (c) Result of CNN Model

(d) Explainability

# Comparison of proposed Core ML model with state-of-art

Parameters	Classifier used	<b>Total samples</b>	Accuracy %	
Sannakki et al.[29]	Neural Networks	33	100%	
Padol et al.[27]	SVM	137	88.89%	
Kharde et al. [21]	ANN	96	93.44%	
Kakade et al. [18]	ANN	155	92.94%	
Kole et al. [22]	Fuzzy set theory	31	87.09%	
Parminder et al. [20]	SVM	400	97.34%	
Proposed Method	Create ML	4062	97.1%	



### Future plans



- 1. Currently our systems is using RESNET-18 model and our plan is to integration MobileNetV2 model as well.
- 2. Develop a semi-autonomous AIRoS: Artificial intelligence based robotic system for grape plant health monitoring using an open-source cloud platform and freely available voice recognition mobile application viz. Alexa or Google or any other voice assistant.

### Prototype AIRoS robot based learning system



# Thank You For Your Attention

