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**Research Proposal: Implementing Online Learning with MobileNetV2 for the Detection of Agricultural Crop Diseases Utilizing Stochastic Gradient Descent**   
  
1**. Introduction**

The agricultural sector faces many problems from crop diseases, resulting in declines in productivity and quality. Timely identification and precise diagnosis of these diseases are essential for effective management. This is based on the utilization of online learning with MobileNetV2, a lightweight convolutional neural network (CNN), to identify crop illnesses from photographs. The model will utilize Stochastic Gradient Descent (SGD) for incremental changes as new data becomes available, ensuring real-time flexibility.

2**. Reason for MobileNetV2 and Online Learning:**

MobileNetV2 is an ideal selection due to its lightweight architecture. It is explicitly engineered for efficient operation on mobile and edge devices, making it appropriate for agricultural settings with potentially constrained computational resources. The model employs depth wise separable convolutions, which considerably lower computational cost while preserving good accuracy. Online learning is essential as it enables the model to incrementally adjust to fresh data. In agriculture, novel crop disease data (e.g., from farms or drones) can be received incessantly. Stochastic Gradient Descent (SGD) enables real-time model updates as fresh data is acquired, eliminating the need for retraining on the complete dataset. This results in improved resource management and real-time adaptation, which is essential for contexts with dynamic data streams.   
  
**3.Objective**

3.1. Modify the MobileNetV2 framework to effectively categorize crop photos and identify illnesses with precision.   
3.2. Implement online learning utilizing SGD to incrementally update model parameters with fresh crop disease data.   
3.3. Evaluate the model's accuracy, convergence rate, and computational efficiency in practical agricultural contexts.   
  
4. **Context**

MobileNetV2's efficiency on resource-constrained devices renders it optimal for agricultural environments, where lightweight models are essential for real-time operation. Online learning facilitates the model's enhancement with each new data batch, permitting adaption without the computing demands of complete retraining.   
  
This integration is crucial for agriculture, where immediate feedback is vital for averting disease outbreaks and reducing crop damage. Upon the availability of new crop photos, the system will promptly update the model, hence maintaining accurate and current detection.   
  
**5. Methodology**

5.1. Data Acquisition: - Novel Plant Pathologies Dataset

This dataset comprises around 87,000 RGB photos of healthy and diseased crop leaves, divided into 38 distinct classifications. The complete dataset is partitioned into an 80/20 ratio for the training and validation sets, maintaining the directory structure. A new directory with 33 test photos is subsequently established for predictive purposes.   
  
5.2. Model Implementation: - Execute MobileNetV2 utilizing TensorFlow or PyTorch.

- Alter the architecture to facilitate online learning, allowing the model to incrementally process new data without the necessity of retraining on the complete dataset.   
  
5.3. Online Learning Framework: -

-Establish a framework for processing incoming data streams of agricultural photographs.   
- Employ Stochastic Gradient Descent for parameter adjustments following each individual image or mini-batch of photos, facilitating real-time adaptation.   
- Implement strategies like adaptive learning rates and regularization to improve model stability and mitigate overfitting in incremental learning.   
  
5.4. Evaluation Metrics: - Assess performance indicators including accuracy, precision, recall, F1-score, and convergence time. Evaluate the efficacy of online learning methodologies in comparison to conventional batch training techniques utilizing typical crop disease datasets.   
  
  
**6. Anticipated Results**

A lightweight model based on MobileNetV2, proficient in the efficient detection of agricultural diseases through online learning.   
- The model exhibits real-time adaptability by incrementally updating with fresh data, hence ensuring ongoing enhancement of performance.   
Performance benchmarks demonstrating the advantages and constraints of online learning for crop disease detection in agricultural settings.   
  
**7. Importance**

This research will offer a viable, scalable approach for real-time diagnosis of crop diseases, allowing farmers and agricultural stakeholders to make timely, informed decisions. This method minimizes computing expenses and improves crop productivity by promptly addressing new disease outbreaks through incremental model updates.   
  
**8. Conclusion**

This project seeks to enhance precision agriculture by incorporating online learning and the streamlined MobileNetV2 architecture. This project investigates novel methods to enhance disease detection accuracy and computing efficiency in agricultural applications through real-time model changes utilizing SGD.   
  
References:   
1. ["Deep Learning in Agriculture: A Review" - A thorough journal article examining AI applications inside the agricultural sector.](https://www.researchgate.net/publication/359243072_Deep_Learning_in_Agriculture_A_Review)   
2. ["MobileNets: Efficient Convolutional Neural Networks for Mobile Vision Applications" - Original research on MobileNet architectures and their efficacy.](https://www.researchgate.net/publication/316184205_MobileNets_Efficient_Convolutional_Neural_Networks_for_Mobile_Vision_Applications)   
3. [New Plant Diseases Dataset](https://www.kaggle.com/datasets/vipoooool/new-plant-diseases-dataset/data)(kaggle.com)   
4. [Stochastic Gradient Descent - An Introduction to Machine Learning (clairedavid.github.io)](https://clairedavid.github.io/intro_to_ml/week2/DL_stochGD.html)   
5. [Lecture5.pdf (cornell.edu)](https://www.cs.cornell.edu/courses/cs4787/2019sp/notes/lecture5.pdf)