

Faster-PestNet: A Lightweight Deep Learning Framework for Crop Pest Detection and Classification

Crops are one of the most essential things for humans. It can be used as a food for human and animal consumption. It has an economic impact. Agriculture is the main source of national income for most developing countries like Bangladesh. Also, it is the biggest source of raw materials. So, it is important for us to protect crops from danger. One of the threats to agriculture is pest infestation. It can cause harm to agriculture productivity leading to substantial crop losses. Farmers use traditional methods for pest detection which is time consuming and less accurate. The demand for less laborious and highly accurate pest detection has increased a lot. Many researchers are trying to use machine learning techniques to automate pest detection. This paper presents a novel model named Faster-PestNet. It is a lightweight Deep learning Framework for Crop pest detection.

Key Contribution:

To create their novel model, they have altered the conventional Faster-RCNN approach by utilizing MobileNet as the base network. They tuned the model on the pest samples to recognize the crops pest of various categories. We know that Mobilenet is lighter than other existing CNN models. It is designed to work with low end devices which makes it perfect for Real-time object identification. This model achieved best accuracy (82.43%) compared to other state-of-the-art models like- ResNet-50, ResNet-101, AlexNet etc.

Methodology:

Model:

In this study, they used Faster-RCNN and Mobilenet to create this model. They swapped the ResNet backbone with MobileNet backbone to use as the Faster R-CNN algorithm's backbone. Therefore, at first MobileNet is applied for calculating a distinctive set of image characteristics. Then optimized and divided by the 2-step locator of the improved Faster-RCNN model.

Dataset:

For model tuning and testing, they have used IP102 which is one of the largest-scale benchmark dataset for pest classification. The dataset consists of 102 categories of crop pests. IP102 is a challenging dataset for classification tasks. As, it contains a wide range of perspective, scale, orientation and illumination changes.

Implementation details:

They used Keras library in TensorFlow to implement the suggested framework. They made changes in the epochs, batch, and learning rate for the model's hyperparameters to create their novel model. The research used Stochastic Gradient Descent (SGD) to train the model. The learning rate was 0.0015. The epoch and batch size was 200 and 32 respectively. The input image dimension 320 X 320. Lastly, the data were split into 70% samples for training, 15% for validation and 15% for testing.

Evaluate parameters:

They have various parameters for knowing their model's effectiveness. They are Precision ,Recall ,F1 and mAP.

Loss function:

They combined Classification and regression loss terms to use as a loss function to train their model.

Performance Comparison:

They analyzed their proposed model to other deep feature extraction frameworks to compare pest detection and classification of them. After analysis, they found that their novel model is better than other deep learning models such as - GoogleNet, ResNet-50, ResNet-101, Inception V4 etc.

Potential applications:

Faster-PestNet has a lot of potential to reduce the pest infestations.

1. Since, it is a lightweight model. It enables real-time pest detection to control pest attack and use pesticides accordingly.
2. It can be integrated with drones for monitoring pest infestations. It will provide early detection, improving pest control systems.
3. We can integrate with robots for pest monitoring and detection. It will accurately detect the pests and control it with necessary actions.

Conclusion:

Faster-PestNet is a lightweight and highly accurate model. As it is integrating MobileNet with Faster-RCNN as its backbones. It performs better on IP102 dataset which makes it suitable for real-time pest detection and other works in the agriculture sector.