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Agricultural Pest and Disease Detection in Banana Plant

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Abstract

Agriculture is the primary source in providing food for the entire nation. Consequently, agriculture is the fundamental origin of food supply. The contributions of agriculture include increase in employment opportunity and economy of the nation. According to IBEF, in India 58% of entire population depends on agriculture as their main occupation. Currently 81.1% of the total agricultural production is produced by livestock farmers. There will be 50% of loss in yield because of pest and disease. The disease in the plant excitants farmers to use unsuitable pesticide which causes unfavorable consequences. This may lead to the reduction in soil and food quality. Besides it has an adverse impact on human life. Nevertheless, farmers are heedless of these effects.

The diseases which are naturally created will cause a serious impact on yields also it will bring down the quality of the food and soil. The symptoms which can cause the less yield are infinitesimal and because of the less human vision potentiality it is difficult to recognize the disease. Plant diseases will require genuine identification and proper categorization of the crops. The developed advanced methodology will identify the diseases, percentage of spread area, pesticide name with the quantity of the pesticide require to heal particular disease using image processing technique.

Keywords: *Image processing, TensorFlow lite, RGB 3D Color model, gray scale image, Object detection.*

1.0 Introduction

Earlier farmers used to examine diseases through visual examination which is not an accurate method. Sometimes experts perform chemical processes which requires a professional expert team and plant interrupted advertency. These executions are not affordable for many of the farmers. In such conditions, the recommended system proves to be helpful in monitoring large crop fields. Automation detection system using image processing is best solution as the system is inexpensive, reliable, less time consumption. Importantly it reduces the improper use of pesticides and fertilizers which causes adverse effects on food quality as well as soil quality.

In India, Banana is the second most important fruit followed by mango. It is the only fruit which is available throughout the year in variety of range. Every part of banana plant is packed with nutrition and health benefits. Banana fruits, raw banana,

banana flower and banana stem can be consumed in different ways. Banana is enriched with fiber, vitamins, iron, potassium and calcium. While eating on the banana leaves holds the significance in religious functions and is more hygienic when compared to utensils. Banana plant tops the holy position in every Indian function and worship. Banana leaves are also used as decoration in southern India. Hence it is important to preserve and increase the banana plant yield.

2.0 Literature Survey

Agriculture researches are aiming to reduce the application of detrimental pesticides and fertilizers which can cause acute health effect and chronic health effect. Over and above children are more open to attack to pesticide exposure as their immunity power is low. Howbeit researches and innovations should be preferably at low cost with an aim to increase in yield of crops and grade of soil.

The author of the paper [1], came to conclusion that convolutional neural network plays a major role in implementing databases, captured image quality is obtained. The insects' called pests are mainly responsible for the loss of production. Therefore, the recognition of such pests is more important to grow the crops healthily. In the paper [2], the diagnostic system is developed depends on transfer learning.

Deep learning methodologies using convolutional neural network models for the detection and diagnosis of disease in plant includes models training with an open data base of 25 distant plants. a brief evaluation of training models was published by the author in [3].

The ill leaf of apple data set is built using both complex and laboratory images via image annotation and data expansion under real-time condition. Five most regular apple leaf disease are used to train the model. These tasks using deep learning based on advanced CNNs are regarded as faster than previous work by the author in [4]. Plants get affected due to unusual climatic variation and improper usage of pests which results in loss of production, has been detailed in paper [5].

Techniques of deep learning applied to perform 40 research survey for various agricultural and food barriers. The source and nature of disease, pre-processing of data had done stated by standard scale by [6].

Multispectral Machine vision system to detect pests is regarded as best pest trapping method compared to the error-prone and time-consuming manual counting. The hyper hue model and normalized hypercubes models are proposed for multispectral data processing with a three-dimensional point cloud to detect twelve variety of pest described by author in [7].

Considering rice as the major yield in India the author in [8] dealt a survey in rice plough field in 2017. The observation of the survey comprises different variety of pests that strike which rice grass plant and their active period in a year. Research work in [9] incorporates detection of disease in tomato leaf using deep learning. Tomato leaves images having similar trait are categorized Convolutional neural network classifier is used to analogize diseased part of leaves with images stored in dataset. The brown planthopper is the most hazardous insect pests which causes prominent yield losses, particularly rice varieties. This idea implants inheritance pattern and controlling activity of genes. Inheritance is the process by which the parental information is transferred from one generation to another generation, this inheritance includes genes which is the basic unit of the hereditary system, this gene refers to the chain-link of enormous nucleotides in DNA blends both RNA and protein. Here Inheritance refers to the process by which the parental information is transferred to one generation to another. Hence the pure line development will be enhanced in such a trait in [10].

The author in [12] illustrated the impact by insect and pest on yard long been which is a well-known vegetable in Cambodia. Furthermore, the author insisted the use of bio-pesticides instead of chemical pesticides application in managing pest in crop. This works appraises the variety of bio-pesticides which are eco-friendly and helps in increase productivity.

The author in [13] dealt with various image processing techniques. The input disease affected leaf image filtered to remove background, noise and distortion. The images are rescaled to the standard size. Using median filter smooth images are obtained. Contrast of images has enhanced using histogram equalization and images are classified using k-means clustering method to select disease influenced portion segments of leaf. The image is partitioned based on the number of best results observed. The similar features of leaves are extracted to detect the disease. The accuracy rate can be improved with the extension of database.

Nowadays Computer vision technologies are getting popularity in efficiently recognizing the pest. Clear and high-resolution images aid to achieve high accuracy. The low-resolution images are magnified using deconvolution method. Faster RCNN is used to detect the object and tarin the model. By performing the reconstruction, the image can be restored so that the pest trap could adapt at a particular pixel scale. The work has been approved as improved pest detection rate and reduced camera density and cost by author in [14].

3.0 Methodology

Samples are collected for healthy banana leaf as shown in Fig.1., and for three diseased banana leaf

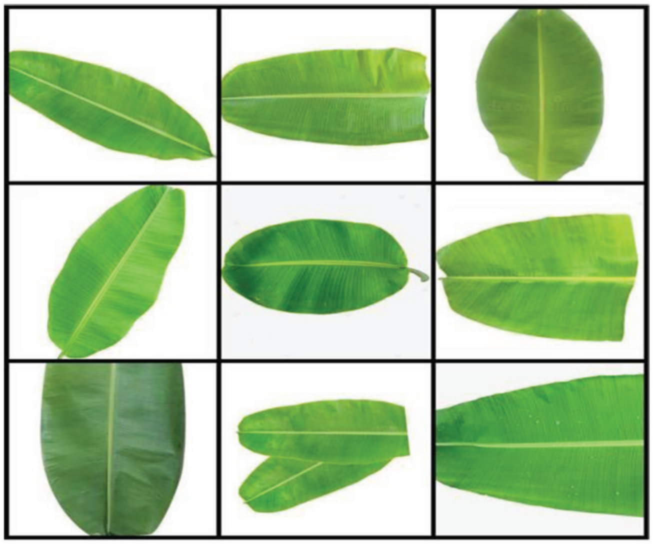

Figure 1: Images of healthy leaf samples to train model

Figure 2: Images of Cordana disease affected leaf samples to train model

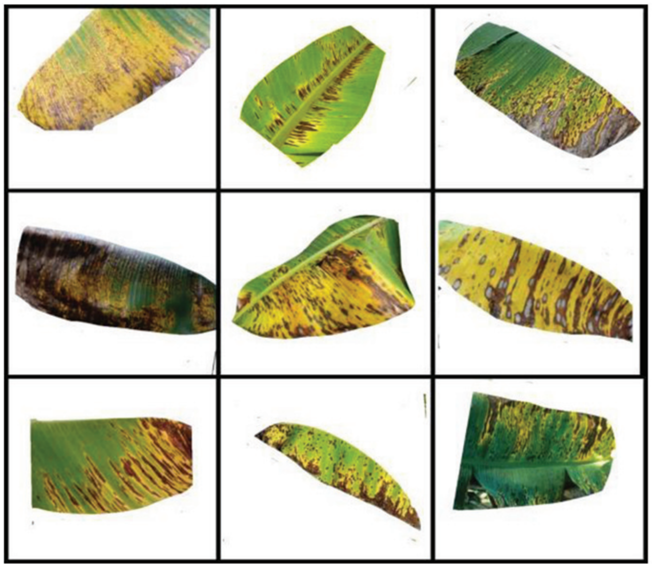

Figure 3: Images of Sigatoka disease affected leaf samples to train model

Figure 4: Images of Pestalotiopsis disease affected leaf samples to train model

particularly Cordana as shown in Fig.2., Sigatoka as shown in Fig.3., Pestalotiopsis as shown in Fig.4., which are the common diseases of banana leaf. Leaf images of 100 samples of pixel value 640x360 are trained. In the next step, out of 100 samples 80 samples are split into train data and 20 samples are split into testdata.

The following figures are the sample images of healthy and disease affected banana leaves to train the raspberry pi model. Training the large numbers of sample data will increases the accuracy of the model.

The RGB images of the banana leaves are captured using camera modules of pixel value 640x480 for real time application which is directly connectedto the Raspberry pi.

These RGB images are converted into grayscale images using luminosity method.

Grayscale=[0.3*Red] +[0.59*Green] +[0.11*blue]

The image has been segregated into four categories which paralleling to different parts of the object.

Appearance of these samples is changed using image filtering then unnecessary parts of the leaf is filtered using image cropping. This could help to reduce unwanted calculations and time consumption. Pixels which belong to the similar disease component are categorized together with a unique label under image labelling.

Tensor flow lite is used which provides the device machine learning by helping programmer to run their paradigm on mobile.

Finally, the recognition process performed. Now the tested samples are compared to the trained samples to display the disease name, pesticide name and percentage of disease affected area.

These steps are repeated for each captured image. Using Raspberry Pi, the result is displayed mobile app which is developed using android studio designed specifically for android development.

3.1. Flowchart (Fig.5)

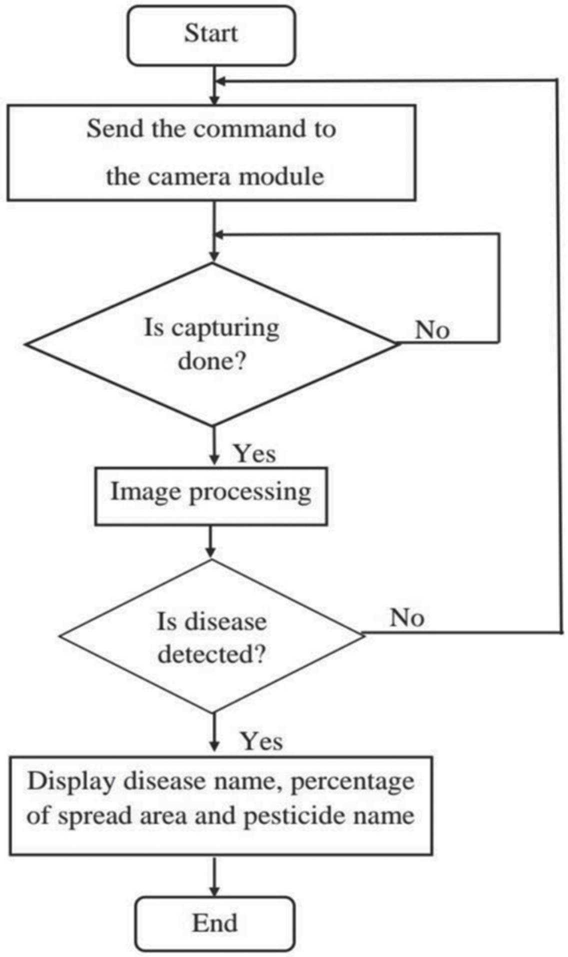

Figure 5: Flowchart representing systematic disease detection by the developed model.

Table 1: Related works on plant disease detection with techniques used and detection efficiency

Authors	Paper Name and Year	Technique Used	Detection Efficiency
Ching-Ju chen, ya- yu huang, yuan-shuoli, chuan- yu chang, yueh-min huang	An IoT based smart agricultural system for pests' detection (2020)	Artificial Intelligence, Image Recognition, IOT	90%.
B. Rajesh, M. Vishnu Sai Vardhan, L. Sujihelen	Leaf Disease Detection and Classifica Tion By Decision Tree(2020)	Decision Tree	95%
Harshita Nagar, R.S.Sharma	A Comprehe Nsive Survey on Pest Detection Technique S Using Image Processin G (2020)	Feature Extraction and Automatic detection	-
Harshita Nagar, R.S. Sharma	Pest detection on leaf using image processin G (2021)	Wavelet Transformat Ion and Oriented Fast and Rotated Brief (Orb).	91.89

5.0 Experimental Results

The outcome of the proposed model includes identification of healthy banana leaves as shown in Figs.6 and 7 and detection of diseased banana leaves. Fig.8 and 9 represent detection of sigatoka disease

Figure 6: Healthy leaf image detection

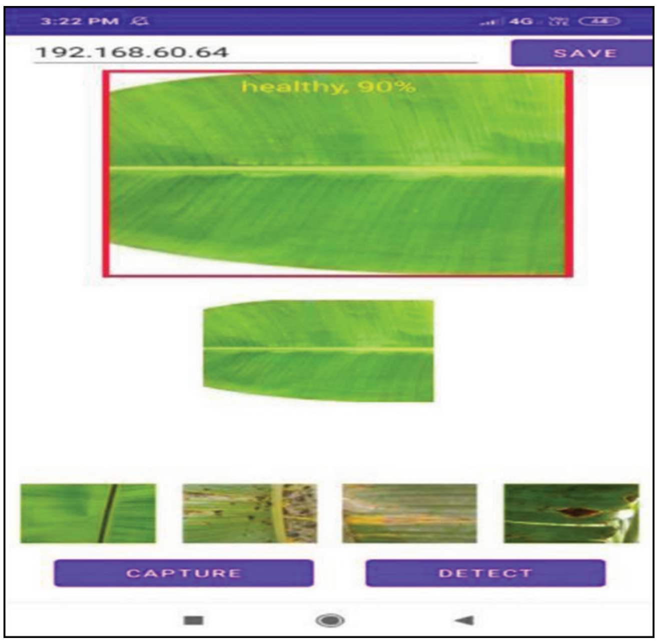

Figure 7: Healthy leaf image detection

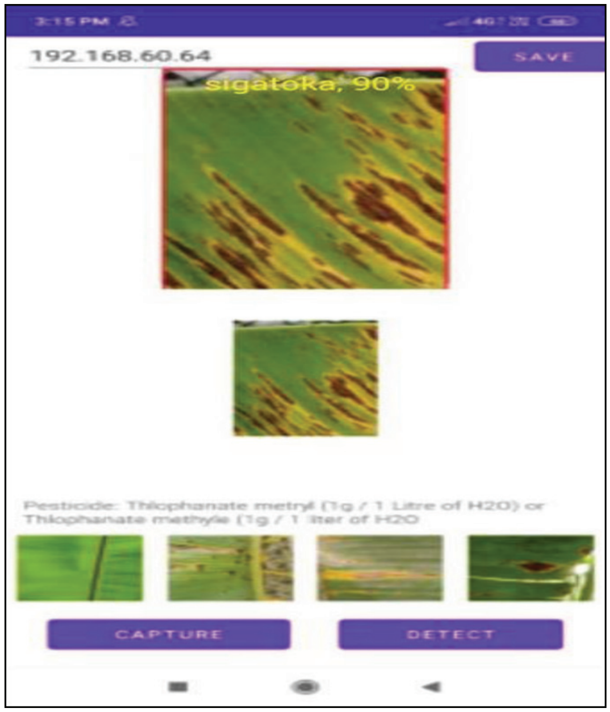

Figure 8: Sigatoka disease detection

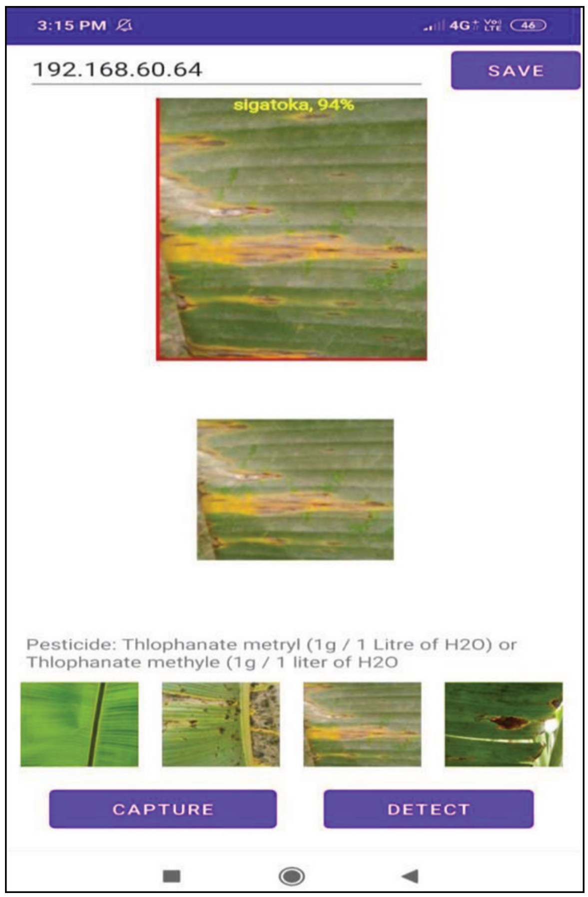

Figure 9: Sigatoka disease detection

Figure 10: Cordana disease detection

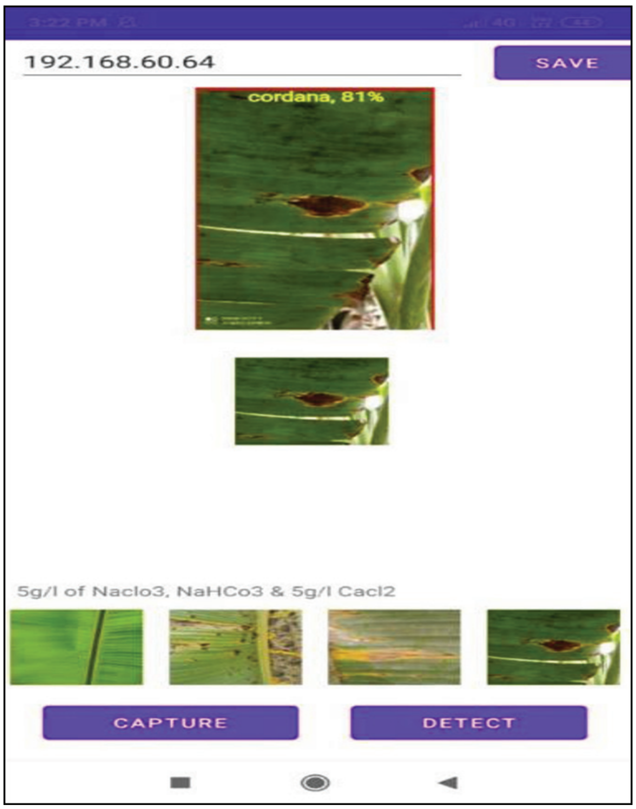

Figure 11: Cordana disease detection

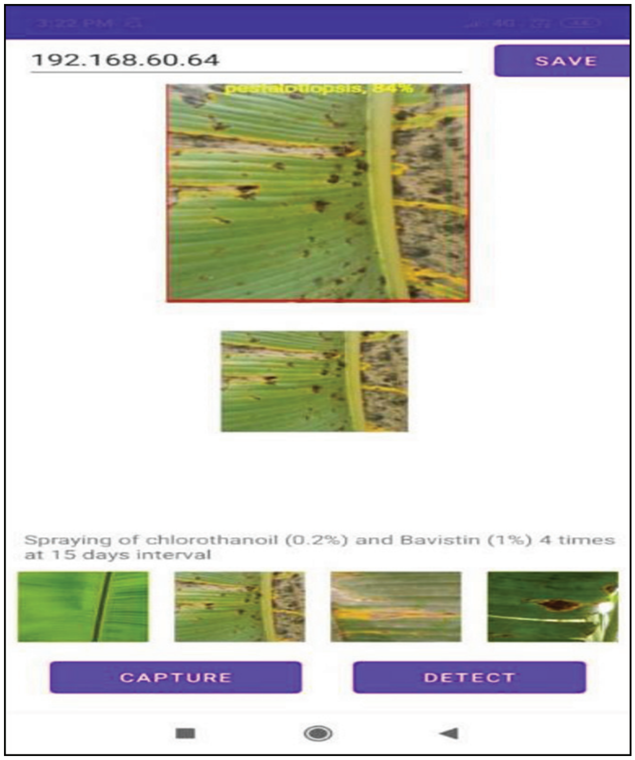

Figure 12: Pestalotiopsis disease detection

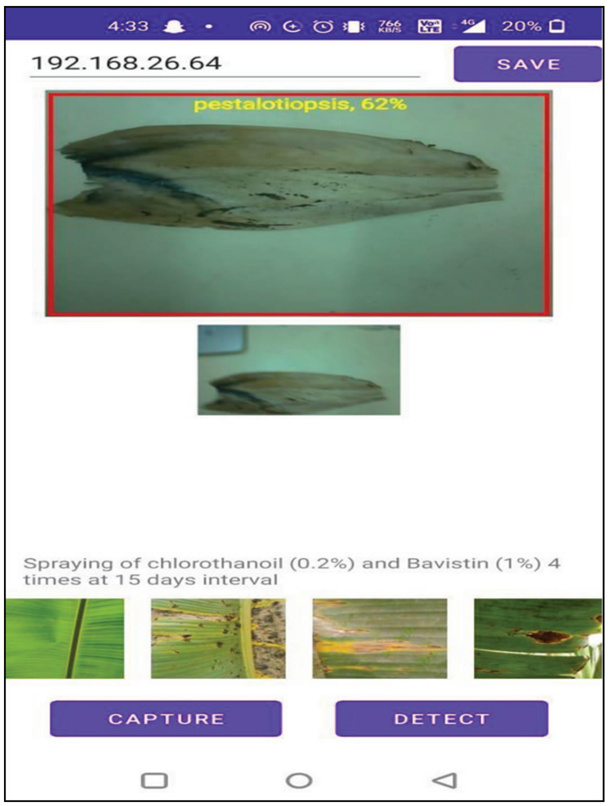

Figure 13: Pestalotiopsis disease detection

which is either black or yellow leaf spot fungus pathogen. Figs.10 and 11 shown below portray detection of cordana disease which appears in pale brown diamond shape with yellow border. Figs.12 and 13 represent detection of pestalotiopsis disease which can be seen as brown spot. In addition to the display of disease name, model will also display the percentage of disease affected area, suitable pesticidename, along with the quantity of the pesticide required heal the particular disease.

5.0 Conclusions

In the proposed work, the banana plant leaves disease detection utilizing digital image processing techniques has been discussed. The designed model provides precise results in detecting healthy and diseased banana leaves together with identifying the kind of diseases among sigatoka, cordana and pestalotiopsis.

The detection accuracy can be improved further by training the model with more sample images. The model can also affix to drone. In addition to these the model can be made for wireless detection. By using servo motors the model can be made movable within the plough land with the deployment of edge detection algorithm on Raspberry Pi. With the aid of advance image processing algorithms, the image can be cropped to only infected chunk of leaves for pesticides application.

The Table 1, shown above represents the various disease detection methods on different crops. These existence models have disclosed only the disease name of different crops. The proposed model has displayed the disease name, percentage of disease affected area, pesticide name and the quantity of the pesticide required to cure the particular disease.

6.0 References

[1] Barbedo, J.G.A. and Castro, G.B. "Influence of image quality on the identification of psyllids using convolutional neural networks", *Biosyst. Eng.*, Vol.182, pp. 151–158, 2019.

[2] Dawei et al., "Recognition pest by image- based transfer learning", *J. Sci. Food Agric.*, Vol. 99, pp. 4524–4531, 2019.

[3] Ferentinos and Konstantinos P., "Deep learning models for plant disease detection and diagnosis," *Computers and Electronics in Agriculture*, vol. 145, pp. 311-318, 2018.

[4] Jiang et al.," Real-Time Detection of Apple Leaf Diseases Using Deep Learning Approach Based on Improved Convolutional Neural Networks", Volume: 7, pp. 06 May 2019.

[5] Jiao et al., "An anchor-free convolutional neural network for multi-categories agricultural pest detection", *Comput. Electron. Agric.*, Vol.174, pp. 505-522, 2020.

[6] Kamilaris et al., "Deep learning in agriculture: A survey," *Computers and Electronics in Agriculture*, vol. 147, pp. 70-90, 2018.

[7] Liu, H and Chahl, J.S.," A multispectral machine vision system for invertebrate detection on green leaves", *Comput. Electron. Agric.*, Vol. 150, pp. 279–288, 2018.

[8] Moses et al., "Identification and quantification of major insect pests of rice and their natural enemies," *Current Journal of Applied Science and Technology*, vol. 32, no. 2, pp. 1–10, 2019.

[9] Krishnaswamy et al., "Tomato crop disease classification using pre trained deep learning algorithm", Procedia computer science, vol. 133, pp. 1040-1047,2018.

[10] Rather and Deo, "Inheritance pattern and gene action of brown planthopper (Nilaparvata lugens Stäl.) resistance in newly identified donors of rice (Oryza sativa L.)," *Cereal Research Communications*, vol. 46, no. 4, pp. 679–685, 2018.

[11] Shen, Y et al., "Detection of stored-grain insects using deep learning", *Comput. Electron. Agric.*, Vol. 145, pp. 319–325, 2018.

[12] Srinivasan et al., "Development and validation of an integrated pest management strategy for the control of major insect pests on yard-long bean in Cambodia," *Crop Protection*, vol. 116, no. 2, pp. 82–91, 2019.

[13] Y. Oo and Htun, "Plant Leaf Disease Detection and Classification using Image Processing", International *Journal of Research and Engineering*, vol. 5, no. 9, pp. 516-523, 2018.

[14] Yue et al., "Deep recursive super resolution network with Laplacian Pyramid for better agricultural pest surveillance and detection", *Comput. Electron. Agric.* Vol. 150, pp.26–32, 2018.