CARDAMOM PLANT DISEASE DETECTION USING ROBOT

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***Abstract*— The cardamom plant has various types of diseases. Among these diseases, leaf blight and leaf spot cause too much damage. Early detection and prevention of these diseases is done with the help of a robot. In this approach, we proceed in several steps. i.e. image collection, image processing, machine learning, image classification and fertilizer design. Cardamom is the queen of spices. It is indigenously grown in the evergreen forests of Karnataka, Kerala, Tamil Nadu and the north-eastern states of India. India is the third largest producer of cardamom. Plant diseases have a disastrous effect on the safety of food production; they reduce the eminence and quantity of agricultural products. Plant diseases can cause significantly high losses or no harvest in severe cases. Various diseases and pests affect the growth of cardamom plants at different stages and crop yields. This study focused on two cardamom plant diseases, Colletotrichum Blight and Phyllosticta Leaf Spot of cardamom and three grape diseases, Black Rot, ESCA and Isariopsis Leaf Spot. Various methods have been proposed to detect plant diseases and deep learning has become the preferred method due to its spectacular success. In this study, U2-Net was used to remove the unwanted background of the input image by selecting multi-scale features. This work proposes an approach for disease detection of cardamom plants using the EfficientNetV2 model. A comprehensive set of experiments was conducted to investigate the performance of the proposed approach and compare it with other models such as EfficientNet and Convolutional Neural Network (CNN).**

Keywords*— *CNN - Convolutional Neural Network GLCM - Gray Level Co-occurrence Matrix DL - Deep Learning ML - Machine Learning SC - Soft Computing CV - Computer Vision AI Artificial Intelligence ANN - Artificial Neural Network

I. INTRODUCTION

The Indian economy is highly dependent on agricultural productivity. Therefore, in the field of agriculture, the detection of plant diseases plays an important role. The disease detection technique is beneficial for detecting plant diseases at the very initial stage. The current method of plant disease detection is mere observation by the naked eye by experts using which identification and detection of plant diseases is done. Therefore, we design a robot that uses image processing to detect leaf spot and leaf blight in cardamom plant leaves. In the field of common, agricultural and plant pathology, experts visit farmland or farmers to identify plant disorders and pests based on familiarity. This approach is not only modest, but also ambitious and ineffective. Farmers with less knowledge may misjudge and use pesticides or insecticides indiscriminately during the screening process. This led to the necessary economic losses. Image processing using an automated approach to plant leaf disease detection is essential to address these issues.

Early detection is the basis for effective prohibition and surveillance of plant foliar diseases and plays a vital role in the surveillance and decision-making of agricultural products. Cardamom is widely used as a flavoring and is widely used in medicine, including allopathy and Ayurveda. It is a mint crop; modern technology for agro-production has been developed and widely adopted in all areas of cardamom cultivation in India. However, the spread of various pests and diseases remains a challenge, which is considered a major production bottleneck facing the cardamom sector. Small cardamom is affected by a number of pathogenic bacteria that seriously damage it crops and is often harmful. Diseases affecting cardamom plants such as Colletotrichum Blight and Leaf Spot have often appeared in fields where the crop is not considered. The occurrence of plant diseases limits agricultural production. If vegetation disturbances are not diagnosed in time, food shortages will intensify. Plant diseases, pests and weeds threaten production and quality agriculture, resulting in crop losses and economic losses. This means about 15- 25 Various other factors degrade the eminence and quantity of agricultural products, such as climate change and modern cultivation techniques with large amounts of chemical fertilizers.

Infected plants often show obvious signs or ulcers on the leaves, stems, flowers or fruits of the plants. In general, each disease or insect environment creates one visual archetype that can be used to interpret anomalies. In general, plant leaves are a significant source of plant disease, and most of the prophetic meaning of disease can initiate the appearance on plant leaves. In the field of common, agricultural and plant pathology, experts visit farmland or farmers to identify plant disorders and pests based on familiarity. This approach is not only modest, but also ambitious and ineffective. Farmers with less knowledge may misjudge and use pesticides or insecticides indiscriminately during the screening process. This led to the necessary economic losses. Image processing using an automated approach to plant leaf disease detection is essential to address these issues. Early detection is the basis for effective prohibition and surveillance of plant foliar diseases and plays a vital role in the surveillance and decision-making of agricultural products. In a recent study, computer vision and machine learning techniques were developed to detect plant leaf diseases. Real-time plant disease detection has some significant challenges such as complex background and disease severity due to images captured in real-time scenarios from the farm field. In this study, detection of cardamom plant diseases was proposed. Cardamom plant leaf images are captured in a farm field with a complex background and a dataset is created to measure the detection capability of the proposed approach. The U2 -Net architecture used in this work, which uses multiscale features to remove the background from the image. State-of-the-art deep learning models such as EfficientNetU2 were used in this work. The key contributions of this work are:

1. Cardamom plant leaf dataset was collected from cardamom plantation in Chinnahalli, Sakaleshpur, India, from April to June 2021, using various electronic devices and set as a reference data set for the subsequent study.

2. Complex image background removed by multiscale feature extraction using U2 -Net.

3. An approach to detect cardamom plant diseases using Efficient-NetV2 was proposed. A set of experiments was conducted to investigate the detection efficiency of the proposed approach. A grape plant leaf dataset was also used to assess the effectiveness of the proposed approach.

, following the example. Some components, such as multi-leveled equations, graphics, and tables are not prescribed, although the various table text styles are provided. The formatter will need to create these components, incorporating the applicable criteria that follow.

II . LITERATURE REVIEW

A. *Evaluation of new fungicides against the leaf blight disease of cardamom, M J Manju*

Cardamom plants suffer from various diseases and pests in different stages of its growth .Among the leaf diseases, leaf blight / chenthal disease caused by fungus In the rainy season, the most devastating ,widespread and economically important leaf diseases of cardamom, in most of the cardamom plant growing regions in India. The symptoms of the disease are initially manifested on the younger leaves as yellowish lesions which later coalesce together to form a large blighted area on

the leaves. The affected area eventually dries up giving a burned appearance to the plant Macozeb + carbendazim(saaf),carbenzim(bavistin),difenconazole(score),hexaconazole(contaf), propiconazole(tilt) are the common and effective fungicides for this disease [9].

B. Plant Disease Detection using Deep Learning

List Of Procedures [7].

- Image Acquisition
- Image pre-processing
- Image enhancement
- Image segmentation
- Image analyzing
- Feature Extraction
- Disease Classification

a. Image acquisition It is the very first step in image processing. It involves collecting images from the plantation for pre- processing using a camera.

b. Image pre-processing It involves the process of suppressing the unwilling distortion, complex background and resizing the images to smaller pixels to ease the computation.

c. Image enhancement Image enhancement is the process of highlighting the area of interest of an image. It involves improving the brightness and contrast.

d. Image segmentation It is the toughest step in image processing and it involves partitioning of an image into its constituent parts .

e. Image analyzing It analyzes which part of the leaves are affected by the disease and compares it with the dataset.

f. Feature Extraction It is the process of extracting and analyzing the affected area only for the classification process. g. Disease Classification It is the process of understanding which disease is affected the leaf to provide the output

C. cardamom plant disease detection approach using effeciantNetV2, Sunil C K

Modern image processing and deep learning-based techniques are widely used for detection of plant leaf disease. The original cardamom plant leaf images had a Leaf blight detection of diseases. CV is the form of Artificial. Fungi often cause diseases that affect plants, and they usually attack leaves. Viruses and bacteria that cause disease cause many others. Farming accuracy has been improved with the increasing use of ML and its related features. The reduction in the amount of production in agriculture harms many humans and animals, and requires modern technology to handle. Easier extractions and disease detection, when an image-based detection system is used due to its higher accuracy and reduce complications and duplicate data. In some plants such as tomatoes, the use of images to identify diseases affecting them and the extent of damage can only be received if there is a high accuracy rate . Investigation of plant diseases revealed many Various factors that determine how the image is based on technology detection. In other words, diseases causing the bumps and changes that are visible on the tree are spots that can be detected using this technology as opposed to causing undetectable damage from plant images. The analysis of this study showed that the plant Diseases are usually discovered when they start to affect the appearance of plants [13].

Figure 1. Sample Data Set

D. Analysis of M L & DL based approaches plant disease

Crop production and quality of yields are heavily affected by crop diseases which cause adverse impact on food security as well as economical losses. In India agriculture is a prime source of income in most rural areas. Hence, there is an intense need to employ accurate CV based techniques for automatic crop disease detection. Infection in crops may cause significant degradation in crop yields as well as quality. So early disease detection, prevention & management are very critical [7][8]. Disease Identification: CV is the sub-domain of AI which allows machines to mimic the human visual system and enable them to precisely draw out, inspect & recognize real world images like a human being does.

E. Plant Disease Detection in Image Processing Using MATLAB

Acquicised images are pre-processed K-means clustering method for partitioning of images into clusters in which at least one part of the cluster contains an image with a major area of the diseased part [10].

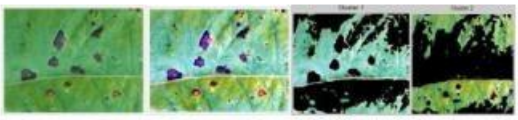

Figure 2. Image Clustering

F. Plant diseases and pest detection based on the deep learning / A review

CNN is one of the efficient and commonly used for segmentation at present. It is a multitask learning method. When the leaves are overlapped and have multiple lesions of the same type, instant segmentation can separate individual lesions and number of lesions [1]. CNN (Convolution neural networks) can perform convolution operations and has a complex network structure consisting of input layer, \convolutional layer ,pooling layer ,full connection layer and output layer[2]. In a single model alternate convolution and pooling layers several times, and when the neurons of the convolution layer are connected to neurons of the pooling layer, no full connection layer is needed.

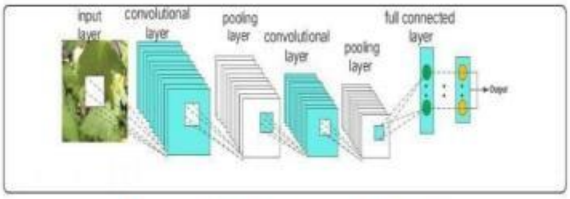

Figure 3. Structure of CNN

G. The personal SMS gateway

Application facility to send SMS without the need for a mobile phone and network. It uses a GSM modem and SIM card to send messages to any mobile network. SMS gateway is used here to send messages about the detected disease with fertilizer suggestions to the farmer's mobile phone. The desktop application can run on any Windows OS and need a GSM modem or GPRS Modem and .NET framework installed. Only 6-10 SMS messages can be sent per minute The connection between the computer and mobile phone and GSM modem does not affect the performance.

H. Leaf disease detection and fertilizer suggestion

As an enhancement, our system also prescribes the fertilizers needed for each detected disease. This is done with the help of a dataset that holds the leaf disease name along with the fertilizers that can be used to treat it. SMS includes the name of the disease and the fertilizer used for the treatment of the detected disease.

I. Enhanced Visual Attention-Guided Deep Neural

For decomposing images into features, CNN uses convolution and pooling operations. SMS includes the name of the disease and the fertilizer used for the treatment of the detected disease. For decomposing images into features CNN uses convolution and pooling operations

J. Plant leaf disease detection using computer vision and machine learning algorithms

Firstly tomato samples are Resized to 256 × 256 pixels and then histogram equalization is used to improve the image quality.K means clustering is used for partitioning the data space into voronoi cells. The boundary of Leaf samples is extracted by using contour tracing.The features is extracted from the leaf sample using various descriptors like discrete wavelet transform, principal component analysis and grey level occurrence matrix.

K. Plant disease by image processing:

A Literature review In this paper surveys on different disease classification techniques like k means clustering SVM, ANN, GLCM, SURF, FUZZY classification are proposed. With very less computational effort the best results where obtained which also shows the efficiency of the algorithm in recognition and classification of the leaf diseases.

L. Green Leaf Disease Detection using CNN

This paper presents surveys conducted on different diseases classification techniques that can be used for sunflower leaf disease detection. Segmentation of Sunflower leaf images, which is an important aspect for disease classification, is done by using CNN algorithm. A variety of neuron-wise and layer wise visualization methods were applied and trained using a CNN, with a publicly available plant disease given image dataset. So, it is observed that neural networks can capture the colors and textures of regions specific to respective diseases. Satisfactory results have been given by the experiments done on leaf images.

M. .Deep Learning-Based Image Processing for Cotton Leaf Disease and Pest Diagnosis.

This study focused to develop a model to boost the detection of cotton leaf disease and pests using the deep learning technique, CNN. To do so, the researchers have used common cotton leaf disease and pests such as bacterial blight, spider mite, and leaf miner. K-fold cross-validation strategy was worn to dataset

splitting and boosted generalization of the CNN model. For this research, nearly 2400 specimens (600 images in each class) were accessed for training purposes. This developed model is implemented using python version 3.7.3 and the model is equipped on the deep learning package called Keras, TensorFlow backed, and Jupyter which are used as the developmental environment. This model achieved an accuracy of 96.4% for identifying classes of leaf disease and pests in cotton plants. Automatic plant pest detection and recognition using Kmeans clustering algorithm and correspondence filters.

This research demonstrates the combination of the k-means clustering algorithm and the correspondence filter to detect and recognize plant pests. It found that the recognition probability is proportional to the height of the output signal and inversely proportional to the viewing angle, and that the correspondence filter can achieve rotational invariance of pests up to 360 degrees.

N. Vision based pest detection based on SVM classification method

Automatic pest detection is a useful method for greenhouse monitoring against pest attacks, but thrips (Thysanoptera) is one of the most harmful pests that threaten strawberry greenhouses. This study used a new image processing technique to detect thrips on crop canopy images using SVM classification method. Results show that using region index and intensify as color indexes make the best classification with a mean percent error of less than 2.25%.

O. U2 -Net: Going deeper with nested U-structure for salient object detection

Recent progress on saliency detection has been largely due to the development of Convolutional Neural Networks (CNNs). Holistically-Nested Edge Detector (HED) provides a skip-layer structure with deep supervision for edge and boundary detection, but the performance gain is not obvious. This paper proposes a new method for saliency detection by introducing short connections to the skip-layer structures within the HED architecture. Our framework provides rich multi-scale feature maps at each layer, a property that is critically needed to perform segment detection. Our method produces state-of-theart results on 5 widely tested salient object detection benchmarks, with advantages in terms of efficiency, effectiveness, and simplicity over existing algorithms.

For the classification, artificial neural network trained with extreme learning machine have been used. The results obtained show the feasibility and effectiveness of the approach to identify and classify foliar damages, and the automatic calculation of the severity.

III . SUMMARY OF LITERATURE REVIEW

Data is collected from plantation and it is trained to the robot. Using image processing we firstly remove the background and compare each picture of leaves with the already trained data of leaf spot and leaf blight. Disease feature extraction and classification is done and the output is the name of the disease

IV . SITE SURVEY

Figure 4. Cardamom Estate

When visited the plantation we found some difficulties rough terrain Grounds are covered with dead leaves and pipes for pesticide spraying and irrigation Due to these difficulties, it is tough to drive the robot through the plantation with limited time and budget Plants have different height (1.5- 3m) Leaves are overlapped by other leaves Insufficient lighting These are the barriers to real-time disease detection So we are proposing a manually controlled prototype.

V. DATASET COLLECTION

Cardamom Plant disease dataset of leaf blight and leaf spot were collected from channahalli estate sakleshpur, India on November 8 ,2022. In this study we collected around 4000 images of three classes leaf blight, leaf spot and healthy category.

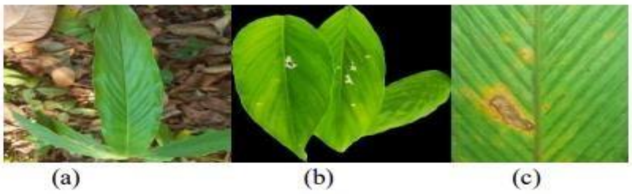

Figure 5. (a) Healthy leaf, (b) Leaf Spot, (c) Leaf blight

accuracy for identification and classification of galls when compared with other approaches. The article concludes with challenges encountered and future works.

VI. BASE DESIGH OF ROBOT

Figure 6. Model base of proposed Robot

VII . HARDWARE CONFIGURATION

The hardware configuration consists of the following concepts.

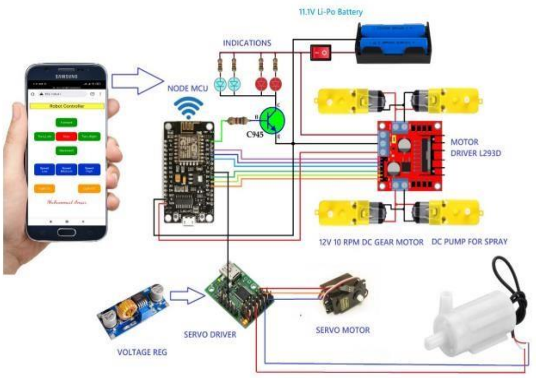

Figure 7 Connection diagram

It consist manually controlled base with a remote controller: The proposed base model is controlled manually using a remote controller. Base consist of Node-MCU, Li-Po battery (1V), DC-Gear Motor (12V, 10 rpm), Motor Driver L293D, Voltage Regulator. Camera, Pesticide Sprayer: DCPump Motor, Servomotor, Servo-driver

TABLE.1 :EQUIPMENT AND SPECIFICATION

Sl.No	Equipment & Specifications	Quantity
1	Node MCU	1
2	DC motor- 12V 45 rpm	6
3	DC driver module- 12V	2
4	Voltage regulator- 5V DC	1
5	DC pumb- 12v 100mA	1
6	Battery- 12v	1

VIII . ADVANTAGES

If we are manually detecting the diseases on the leaves so many human errors can be involved. It can be avoided by using the robot. The base of the robot is designed in such a manner that can be driven through any rough surface by providing wheels covered by a belt (tanker model). When the disease is manually detected by humans, health issues may occur due to the harmful pesticides used for the cardamom so by using the robot we can avoid these harmful effects for people. After detecting the disease we are sending SMS to the farmers phone which includes the efficient and effective pesticides for the detected disease.

IX . DISADVANTAGES

For installing the robot newly to the plantation is costly Weather conditions like rain, wind, fog, sunlight temperature can alter the capturing condition and reduce the quality of image.

X . FUTURE SCOPE

We can detect the disease of any plant by training the model using the respected datasets Forecasting of disease in the early stage, so that appropriate measures can be taken to minimize the loss in crops. It can also be implemented in real time mobile applications and web services

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XI . CONCLUSION.

An efficient plant leaf disease detection approach to detect plant diseases in real-time was proposed. Machine learning methods are used to train the mode. Initial stage disease detection is proposed.

References

[1] J.G. Arnal Barbedo, ‘‘Plant disease identification from individual lesions and spots using deep learning,’’

Biosystems Eng., vol. 180, pp. 96–107, Apr.2019, doi:10.1016/j.biosystemseng.2019.02.002.

[2] E. C. Too, L. Yujian, S. Njuki, and L. Yingchun, ‘‘A comparative study of fine-tuning deep learning models for plant disease identification,’’ Comput. Electron. Agric., vol. 161, pp. 272–279, Jun. 2019, doi: 10.1016/j.compag.2018.03.032.

[3] K. Zhang, Z. Xu, S. Dong, C. Cen, and Q. Wu,"Identification of peach leaf disease infected by Xanthomonas campestris with deep learning ,"Eng. Agricult, Environ. Food, vol. 12, no.4, pp. 388-396,Oct 2019, doi: 10.1016/j.eaef.2019.05.001

[4] S. Zhang, S. Zhang, C. Zhang, X. Wang, and Y. Shi, ‘‘Cucumber leaf disease identification with global pooling dilated convolutional neural network,’’ Comput. Electron. Agricult., vol. 162, pp. 422–430, Jul. 2019,doi: 10.1016/j.compag.2019.03.012.

[5] J. Ma, K. Du, F. Zheng, L. Zhang, Z. Gong, and Z. Sun, ‘‘A recognition method for cucumber diseases using leaf symptom images based on deep convolutional neural network,’’ Comput. Electron. Agricult., vol. 154, pp. 18–24, Nov. 2018, doi: 10.1016/j.compag.2018.08.048.

[6] M. Brahimi, K. Boukhalfa, and A. Moussaoui, ‘‘Deep learning for tomato diseases: Classification and symptoms visualization,’’ Appl. Artif. Intell., vol. 31, no. 4, pp. 299–315, Apr. 2017, doi: 10.1080/08839514.2017.1315516.

[7] J. G. M. Esgario, R. A. Krohling, and J. A. Ventura, ‘‘Deep learning for classification and severity estimation of coffee leaf biotic stress,’’ Comput. Electron. Agricult., vol. 169, Feb. 2020, Art. no. 105162, doi: 10.1016/j.compag.2019.105162.

[8] J. Chen, J. Chen, D. Zhang, Y. Sun, and Y. A. Nanehkaran, ‘‘Using deep transfer learning for image-based plant disease identification,’’ Comput. Electron. Agricult., vol. 173, Jun. 2020, Art. no. 105393 doi: 10.1016/j.compag.2020.105393.

[9] M. J. Manju, S. K. Mushrif, T. H. Shankarappa, L. N. Hegde, A. Gowda, M. S. Lokesh, and N. Naik,‘‘Evaluation

of new fungicides against the leaf blight disease of cardamom [Elettaria cardamomum Maton] in arecanut based intercropping system,’’ J. Pharmacognosy Phytochem., pp. 283–285, Mar. 2018.

[10] F. Fina, P. Birch, R. Young, J. Obu, B. Faithpraise, and C. Chatwin,‘‘Automaticplant pest detection and recognition using K-means clustering algorithm and correspondence filters,’’ Int. J. Adv. Biotechnol. Res., vol. 4, no. 2, pp.189–199, Jul. 2013.

[11] A.-K. Mahlein, M. T. Kuska, J. Behmann, G. Polder, and A. Walter, ‘‘Hyperspectral sensors and imaging technologies in phytopathology: State of the art,’’ Annu. Rev. Phytopathol., vol. 56, no. 1, pp. 535–558, Aug. 2018.

[12] M. Ebrahimi, M. Khoshtaghaza, S. Minaei, and B. Jamshidi, ‘‘Vision based pest detection based on SVM classification method,’’ Comput. Electron. Agricult., vol. 137, pp. 52–58, May 2017. [12] X. Qin, Z. Zhang, C. Huang, M. Dehghan, O. R. Zaiane, and M. Jagersand, ‘‘U2 – Net: Going deeper with nested Ustructure for salient object detection,’’ Pattern Recognit., vol. 106, Oct. 2020, Art. no. 107404.

[13] M. Ebrahimi, M. Khoshtaghaza, S. Minaei, and B. Jamshidi, ‘‘Vision based pest detection based on SVM classification method,’’ Comput. Electron. Agricult., vol. 137, pp. 52–58, May 2017. [12] X. Qin, Z. Zhang, C. Huang, M. Dehghan, O. R. Zaiane, and M. Jagersand, ‘‘U2 -Net: Going deeper with nested Ustructure for salient object detection,’’ Pattern Recognit., vol. 106, Oct. 2020, Art. no. 107404.

[14] M. Tan and Q. V. Le, ‘‘EfficientNetV2: Smaller models and faster training,’’ 2021, arXiv:2104.00298. [14] G. L. Manso, H. Knidel, R. A. Krohling, and J. A. Ventura, ‘‘A smartphone application to detection and classification of coffee leaf miner and coffee leaf rust,’’ 2019, arXiv:1904.00742. [8] S. Zhang, X. Wu, Z. You, and L. Zhang, ‘‘Leaf image based cucumber disease recognition using sparse representation classification,’’ Comput. Electron. Agricult., vol. 134, pp. 135– 141, Mar.