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Implementation of Fertilizer Recommendation System for Disease Prediction Using Deep Learning Algorithm

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ABSTRACT

In addition to providing food for a growing population, agriculture also helps to combat global warming and is a source of energy. Because they may have a detrimental effect on the type and quantity of produced in agriculture, plant diseases are particularly significant. Identification of plant diseases at an early stage is essential for treatment and crops disease management. To identify ailments, people frequently use their naked eyes. This technique involves experts with the capacity to spot variations in leaf colour. This process is labor-intensive, time-consuming, and unsuitable for large fields. Multiple medical experts would frequently give various diagnoses for the same illness. Due to the ongoing need for professional supervision, this technology is expensive. Plant diseases can increase the cost of agricultural output and, if left untreated, can completely bankrupt a company. To control the spread of a plant disease at a low cost and save the bulk of the harvest, growers must keep an eye on their crops and be able to identify early indications. Expert agriculturists may be excessively expensive to hire, especially in rural and inaccessible regions. An alternative way to plant monitoring can be provided by a deep learning algorithm embedded in a picture, and this method can be managed by a specialist to offer less expensive services. It includes features extraction and classification, as well as an image classification method that anticipates several illnesses in maize leaf using a neural network approach. Additionally, adapt the method to prescribe fertilizers based on severity analysis and data.

Keywords: Agriculture; Early Indications; Diseases; Fertilizer Recommendation System.

1. Introduction

Deep learning is a method for teaching computers to learn by doing what comes easily to people. Driverless cars use deep learning as a vital technology to recognize stop signs and tell a pedestrian from a lamppost apart. It is essential for voice control on consumer electronics including. Hands-free speakers, tablets, TVs, and smart phones. Recently, deep learning has attracted a lot of interest, and for good reason. It is producing outcomes that were previously unattainable. A computer model learns to carry out categorization tasks directly from pictures, text, or voice using deep learning.

Modern precision may be attained by deep learning models, sometimes even outperforming human ability. A substantial collection of labelled data and multi-layered neural network architectures are used to train models. You do not need to know the features that are utilized to categorize pictures because CNNs conduct the manual feature extraction for you. The CNN uses direct feature extraction from pictures to operate. The pertinent characteristics are learnt when the network is trained on a set of photos, rather than being pre-trained. Deep learning models for computer vision applications like object categorization are very accurate because to this automatic feature extraction.

Optimized Probabilistic Neural Network based Automatic Detection of Maize Plant Disease Detection to avoid the plant disease, lot of machine learning algorithms are developed namely, Support Vector Machine (SVM), Artificial Neural Network (ANN), recurrent neural network, K-Nearest Neighbour (KNN), Fuzzy Logic Classifier (FLC) and Deep Neural Network (DNN), etc [1]. Plant disease detection using computational intelligence and image processing, several techniques have been developed for Initiating from a discussion on various diseases in plants and plant pathology (Plant pathology section), a plant disease detection architecture is generalized (Components of plant disease detection system section). The accuracy and computational complexity of disease detection systems depend very much on feature extraction, selection of best applicable feature descriptors, and feature selection [2-8].

A computer vision system for automatic plant species identification is main characteristics of disease detection are speed and accuracy [10]. Hence working on development of automatic, efficient, fast and accurate which is use for detection disease leaf. Work can be extended for development of machine vision system that automatically recognizes, classify and quantitatively detects leaf disease symptoms [5].

Image segmentation using computational intelligence techniques show that CNNs trained on whole leaves and leaf patches exhibit different contextual information of leaf features. We categorise them into global features that describe the whole leaf structure and local features that focus on venation [9].

This paper is proposed to detect the plant leaf diseases using deep learning algorithm:

○ Initially, the image will be uploaded, then converted from RGB to grey scale image.

○ Then the image is enhanced by resizing and remove a noise.

○ Then the feature extraction and segmentation process further through modules.

○ At last analyze the disease and recommend a fertilizer.

Section 2 provides a Deep learning framework for tree leaves based disease prediction. Section 3 is about the Result and Discussion and Section 4 is about Conclusion.

2. Plant disease prediction using CNN Algorithm

Plant disease identification by sight is a more time-consuming and inaccurate task that can only be performed in limited locations. Automatic detection, on the other hand, requires fewer efforts, takes less time, and is more accurate. Brown and yellow spots, early and late scorch, and fungal, viral, and bacterial infections are some of the common diseases encountered in plants. In this project we implement a method designed to deal with the obstacles raised by such complex images, for simple and lobed tree leaves.

A first segmentation step based on a light polygonal leaf model is first performed, and later used to guide the evolution of an active contour. Combining global shape descriptors given by the polygonal model with local curvature-based features, the leaves are then classified over leaf datasets. And implement classification algorithm which includes Convolutional neural network algorithm to classify the diseases and recommend the fertilizers to affected leaves.

Based on CNN algorithm, model file build and in future analysis predict the disease with improved accuracy rate. Images are captured with a digital camera on a cell phone and processed with image growing software, after which the leaf sport is utilized for train and test categorization. Both image processing techniques and advanced computing techniques have been incorporated into the system.

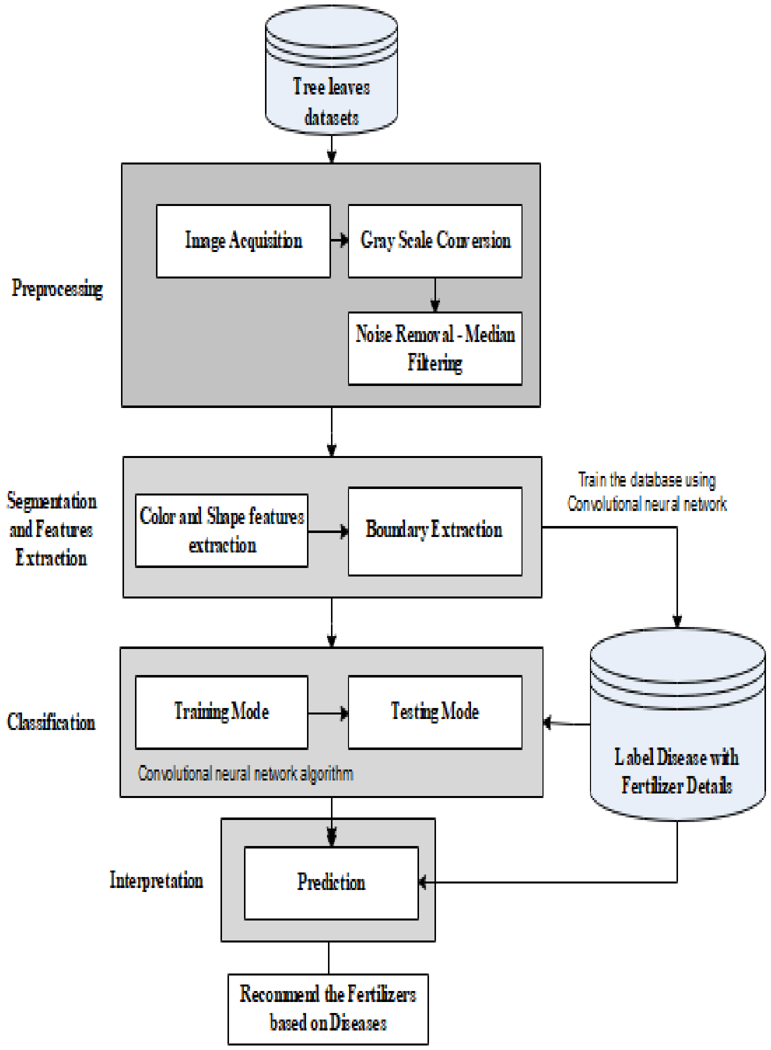

Figure 1. Block diagram of methodology

(a) Leaf Image Acquisition: Leaves are structures specialized for photosynthesis and are arranged on the tree in such a way as to maximize their exposure to light without shading each other. In this module, we can upload the leaf images from the datasets. This database called LEAF was originally created for experiments with recognition of wood species based on a leaf shape. In this module, we can input the corn leaf image datasets.

(b) Preprocessing: In this module convert the RGB image into gray scale image. The colors of leaves are always green shades and the variety of changes in atmosphere because the color features having low reliability. Therefore, to recognize various plants using their leaves, the obtained leaf image in RGB format will be converted to gray scale before pre-processing. The formula used for converting the RGB pixel value to its grey scale counterpart is given in Equation 1.

$$Gray = 0.2989 * R + 0.5870 * G + 0.1140 * B \qquad (1)$$

Where R, G, B correspond to the color of the pixel, respectively.

Then remove the noises from images by using filter techniques. The goal of the filter is to filter out noise that has corrupted image.

(c) Image Segmentation: In this module, we can implement CNN algorithm with automatic descriptors. CNN algorithm is to pass the preprocessed image through a series of convolutional layers. These layers perform feature extraction by applying a set of filters to the image. Each filter produces a feature map that highlights a particular feature in the image, such as edges or corners. After each convolutional layer, a pooling layer is added to reduce the spatial dimensions of the feature maps. The activation function is applied to the output of each layer to introduce non-linearity. Finally, a loss function is applied to the output segmentation mask and the ground truth mask to calculate the error between them. The error is then back propagated through the network to update the weights.

(d) Disease Prediction: Leaves are affected by bacteria, fungi, virus and other insects. In this module implement Convolutional neural network algorithm with multi-class to classify the leaf image as normal or affected. Layers are constructed based leaf features such as color, shape, textures. Then layers can be constructed with conditions to categorize the preprocessed leaves.

(e) Fertilizer Recommendation: Fertilizer recommendations are not typically based on leaf diseases alone. In this module recommend the fertilizer or pesticides for affected leaves based on severity level. Fertilizers may be organic or inorganic. Admin can store the fertilizers or pesticides based on disease categorization with severity levels. The measurements of pesticides can be extracted based on disease severity.

2.1. Convolutional Neural Network

Step 1 Convolution Operation with Rely Activation Function

The objective of the Convolution operation is to find features in the image using feature detectors to preserve the special relationship between pixels. Rely activation function is used to break linearity and want to increase non-linearity because images are themselves are highly non-linear.

Step 2 Pooling

Pooling is a down-sampling operation that reduces dimensions and computation, reduces over fitting as there are fewer parameters and the model is tolerant towards variation and distortion.

Step 3 Flattening

Flattening is used to put pooling output into one dimension matrix before further processing.

Step 4 Fully Connected Layer

A fully connected layer forms when the flattening output is fed into a neural network which further classifies and recognized images. And also implement multiclass classifier; we can predict diseases in leaf images with improved accuracy.

3. Result and Discussion

Different performance measures such as accuracy, sensitivity, specificity, error rate and precision can be derived for analyzing the performance of the system. True positive (TP): number of true positives - perfect positive prediction. False positive (FP): number of false positives - imperfect positive prediction. True negative (TN):

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number of true negatives - perfect negative prediction. False negative (FN): number of true negatives - imperfect negative prediction.

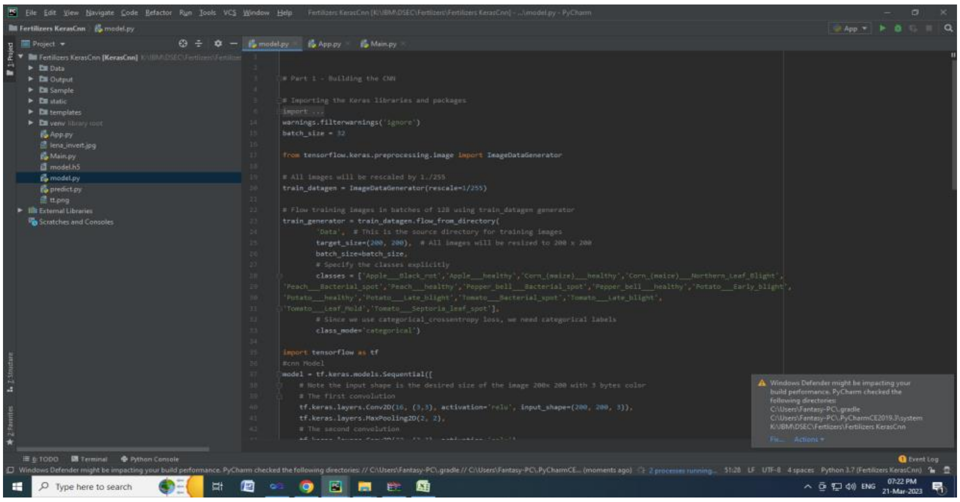

Figure 2. Output Analysis

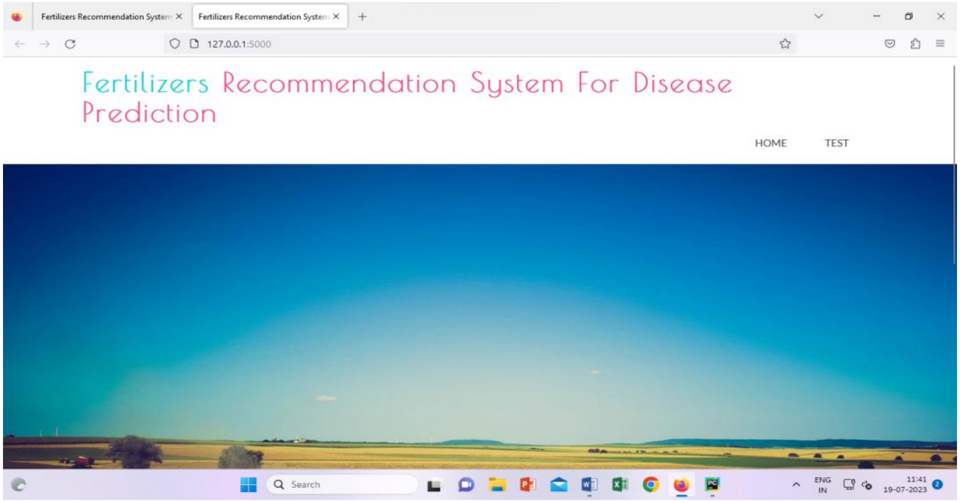

Figure 3. Fertilizer Recommendation system for Disease Prediction

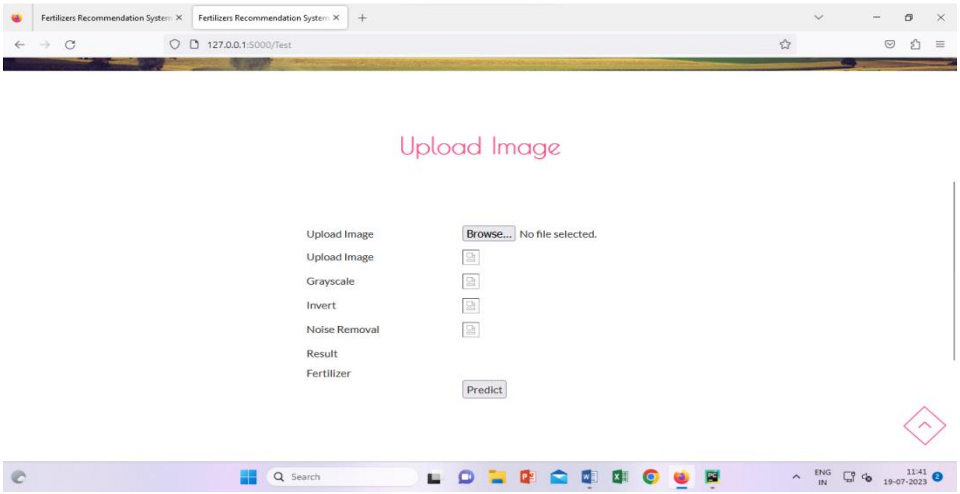

Figure 4. Upload Image

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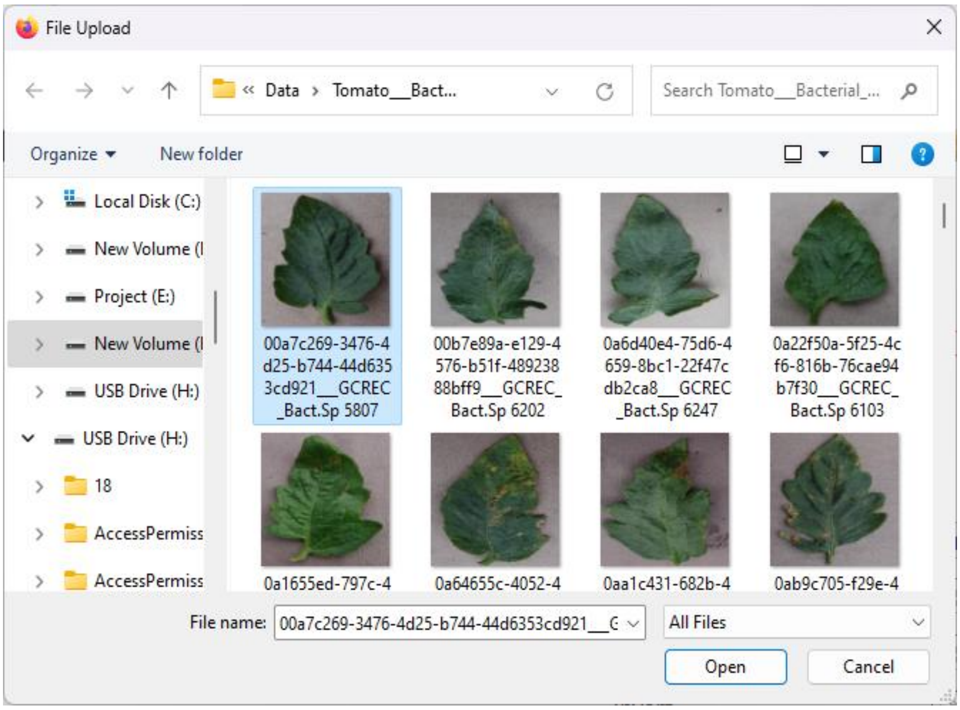

Figure 5. Trained database

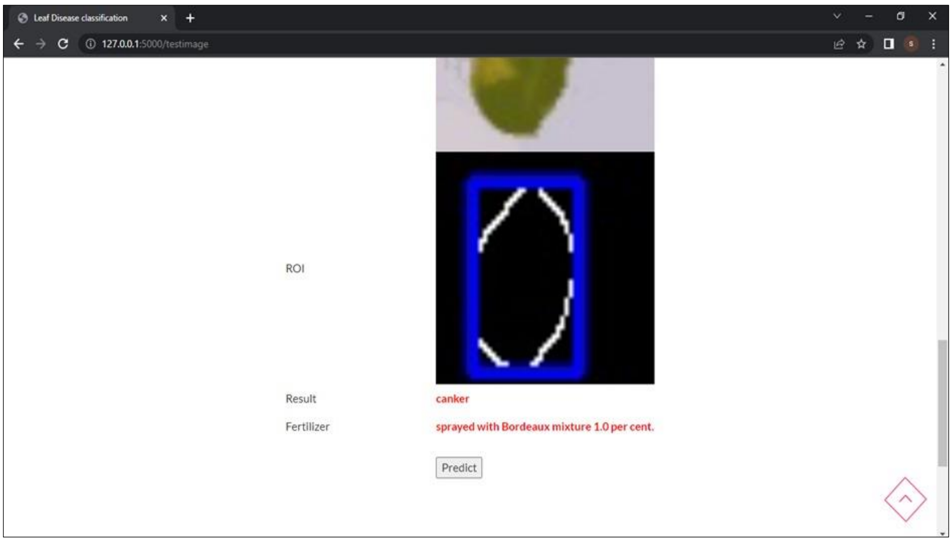

Figure 6. Fertilizer recommendation

3.1. Report analysis

Table 1. Performance analysis

Algorithm	Accuracy
Naive Bayes Classifier	40%
Support Vector Machine	55%
Convolutional Neural Network	90%

4. Conclusion

In this study, we examined the many segmentation and classification approaches, strategies, and algorithms that have been proposed to improve segmentation quality. The results show that segmentation approaches do not perform well and are challenging to use in large datasets, in contrast to the proposed graph cut model. We have offered a technique for segmenting a leaf in a natural picture based on the optimization of a polygonal leaf model that was utilized as a shape prior for a precise of grab cut segmentation. Additionally, it has a set of global geometric descriptors that, when combined with regional characteristics based on the final contour's curvature; allow the classification of different tree species. A color model that can withstand variations in illumination serves as the foundation for the segmentation technique. However, a global color model for the entire image might not be appropriate for leaves that cannot be sufficiently described by color alone. An adaptive color model or the addition of a texture model may produce a noticeable improvement. Finally, classify leaf infections into the following three groups: bacterial, fungal, and viral, using a neural network classification technique. Thereafter, depending on the measurements, recommend fertilizers to the afflicted leaves.

Declarations

Source of Funding

This study has not received any funds from any organization.

Conflict of Interest

The authors declare that they have no conflict of interest.

Consent for Publication

The authors declare that they consented to the publication of this study.

Authors' Contribution

All the authors took part in literature review, research, and manuscript writing equally.

References

[1] Akanksha Eisha, Neeraj Sharma & Kamal Gulati (2021). OPNN: Optimized Probabilistic Neural Network based Automatic Detection of Maize Plant Disease Detection. International Conference on Inventive Computation Technologies (ICICT), IEEE.

[2] Bharate, Anil A., & Shirdhonkar, M.S. (2017). A review on plant disease detection using image processing. International Conference on Intelligent Sustainable Systems (ICISS), IEEE.

[3] Chaki Jyotismita, Ranjan Parekh, & Samar Bhattacharya (2015). Plant leaf recognition using texture and shape features with neural classifiers. Pattern Recognition Letters, 58: 61–68.

[4] Kumar Neeraj et al. (2012). Leafsnap: computer vision system for automatic plant species identification. European conference on computer vision, Springer, Berlin, Heidelberg.

[5] Naresh, Y.G., & Nagendraswamy, H.S. (2016). Classification of medicinal plants: an approach using modified LBP with symbolic representation. Neuro computing, 173: 1789–1797.

[6] Larese, Mónica G. et al. (2014). Automatic classification of legumes using leaf vein image features. Pattern Recognition, 47(1): 158–168.

[7] E.C. Too, L. Yujian, S. Njuki & L. Yingchun (2018). A comparative study of fine-tuning deep learning models for plant disease identification. Comput. Electron. Agricult. doi: 10.1016/j.compag.2018.03.032.

[8] S.S. Chouhan, A. Kaul & U.P. Singh (2018). Image segmentation using computational intelligence techniques: Review. Archives of Computational Methods in Engineering, Dotrich, The Netherlands, Springer.

[9] Vishnoi Vibhor Kumar, Krishan Kumar & Brajesh Kumar (2021). Plant disease detection using computational intelligence and image processing. Journal of Plant Diseases and Protection, 128(1): 19–53.

[10] S.W. Chen et al. (2017). Counting apples and oranges with deep learning: A data-driven approach. IEEE Robot. Autom. Lett., 2(2): 781–788. doi: 10.1109/LRA.2017.2651944.