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Plant Leaf Disease Detection using Deep Learning and CNN

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Abstract – *All around the globe, problems such as forest extinction and food shortage are major concerns for economic development of a country and social welfare of the people. There are different reasons for these issues. One of the main reasons for these problems is diseases occurring in the plant leaf. The potential threat to humans and other animals because of the plant disease is immense. This paper attempts to provide an end-to-end solution to automate the detection of plant leaf disease and provides alert starting from the source.*

Through this paper we propose to create a novel low-cost implementation of disease detection using state-of-the art Deep learning concepts like Convolutional Neural Network, Activation Functions, binary_crossentropy combined with fundamental principles of RDBMS and UI/UX Our solution aims to be a robust, low-cost, hardware-independent and seamless solution for disease detection in present times. The experimental accuracy of this system is 96.4% which is good enough for real-world scenarios.

Key Words: **Deep Learning, Convolutional Neural Network, Binary Cross Entropy, RDBMS, Activation Function**

1. INTRODUCTION

Plant disease have impacted society and world history. All varieties of plants wild and cultivated alike, are subject to disease. The result of the plant losses due to disease can result in hunger and starvation. Many valuable crops might be very susceptible to disease and it might be a possibility that survival of such plants without human intervention is not possible. In such cases early detection would be utmost important in order to prevent the further spread of disease to other parts of the plant. The proposed solution using deep learning techniques would be a vital component to solve these issues as it does not involve any hardware component and it is a seamless solution with high accuracy to detect diseases in leaf as early as possible and take appropriate measures.

It has become a very tedious problem for farmers to detect the plant disease and treat it with appropriate measures as early as possible. The current system that are in use are ineffective and time-consuming. So using CNN based model for disease detection would be a low-cost and an effective approach to solve this problem.

In deep learning, a convolutional neural network (CNN, or ConvNet) is a class of deep neural network, most applied to analyse visual imagery. CNNs are more efficient than other image classification algorithms. As they utilize little pre-processing The learning is completely automated in CNN

whereas in traditional algorithms these filters are hand-engineered. This independence from prior knowledge and completely automated without any human intervention in feature extraction is a major advantage.

2. Literature Survey

Vijai Singh et all [1] describe the plants plays an important role in agriculture field, as having disease in plants are quite natural. This paper subtly informs that proper care should be taken in certain area else it causes serious effects in plants. This paper proposes an algorithm for image segmentation which is used for automatic detection and classification of plant leaf diseases.

Amar Kumar Deya et all [2] discuss leaf rot disease detection for betel vine (Piper betel L.) based on image processing algorithm. This paper presents the drawback of current manual detection and uses identifying color feature of the rotted leaf areas to find detection in plant diseases. Subsequently, the rotted area was segmented, and area of rotted leaf portion was extracted from the various plant feature data. The results showed a performance of this automatic vision-based system in practice with easy validation.

A.P Soni et all [3] Proposed a green heart shaped betel leaf, in India it is known as Paan. This paper covers the easy, accurate, and less human intervention method of leaf area measurement. Leaf area of plants is a useful tool in physiological and agronomic studies. Around 1000 betel leaf investigation is performed and the paper includes important aspects of these investigation. These results are in turn compared with the graphical technique of leaf area measurement. The advantage of this method is the easiness and the accuracy of finding the estimated leaf area precisely.

Daisy shergill& et.al.,[4] describes a approach is useful in crop protection especially in large area farms, which is based on automated techniques that can detect diseased leaves using color information of leaves. The disease can be detected by capturing an image of a certain plant leaf

followed by extracting feature from the captured image. First the captured RGB image is converted to gray image and then gray image is resized and perform canny edge detection, apply various comparison techniques, which detect the presence of disease and also the type of diseases. It enables to find the disease early so that appropriate measures can be taken.

RenukaRajendraKajale [5] describes the approach for detection and computation of texture information for plant leaf diseases. The processing system consists of four main steps, color image is converted to HSI, then the green pixels are masked and removed using specific threshold value, then the preprocessed image is divided, and the useful segments are extracted, finally most important information which is texture is obtained in this algorithm. obtained. The diseases present on the plant leaf are evaluated based on the texture information.

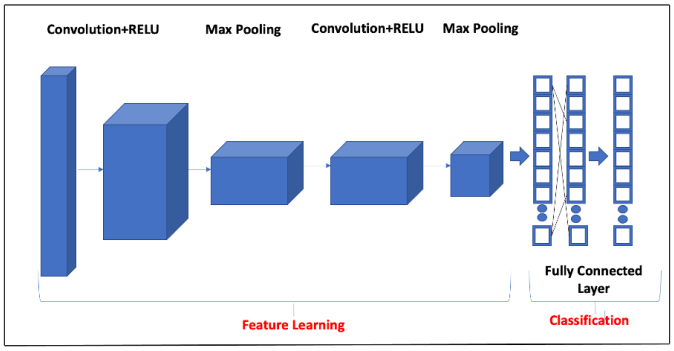
Prakash M. Mainkar& et.al.,[6] provides a software solution to automatically detect and classify plant leaf disease. This approach will increase productivity of crops. It includes series of steps which are acquisition of image, image preprocessing, segmentation, feature extraction and classification.

Niket Amoda& et.al., [7] provide image processing-based solutions that are highly automatic, less cost and accurate. Solution is composed of four main steps; in the first step the RGB leaf image is transformed to other color model. Next, in the second step, the images which are transformed are segmented to obtain the most important information. In the third step, the calculation is done based on the features of texture of leaf.. Finally, in the fourth step the classification is done by using pre-trained neural network based on the result of feature extraction. Overall, the approach of training deep learning models on increasingly large and publicly available image datasets presents a clear path towards smartphone-assisted crop disease diagnosis on a massive global scale.

3. Proposed System

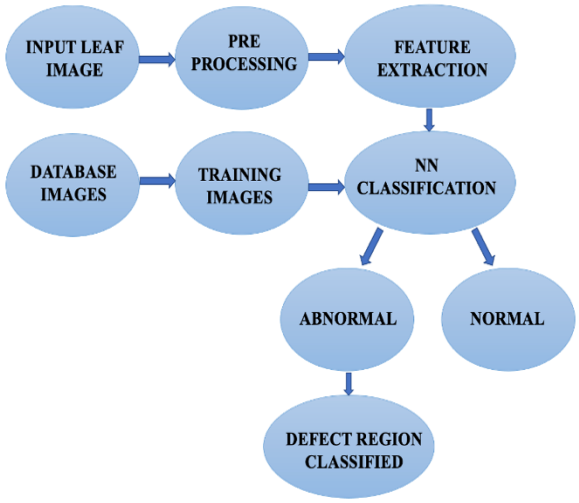
The Proposed system opted to develop is an algorithm used to recognize diseases in crop leaves by using convolutional neural network. Devices like digital camera or any identical device are used to take the pictures of affected part of plant, these images are then used to identify the affected area in leaves. Finally image-processing techniques are applied on them, to process those images and obtain unique and important features needed to analyze later. This model is properly trained using CNN and then the classification takes place. Then the comparison of the test image and trained model takes place followed by the display of the result. If there is a defect or disease in the plant the software displays the result

4. System Architecture



A convolutional neural network is made up of input layer, hidden layers and an output layer. In a feed-forward neural network, these middle layers are being addressed as hidden layers because the inputs being fed to hidden layers and output generated from them are masked by activation function and final convolution. In a convolutional neural network, the hidden layers are most essential as they perform convolutions. This Conv layer does most of the heavy lifting. The output from Conv layer is termed as Feature Map which gives us the important information of the image. Following these, CNN consists of layers like Pooling layers, fully connected layers and normalization layers which will help to process the image and provide results more accurately. The primary application of pooling layer is to reduce the computational cost by decreasing the size of convolved feature map. The fully connected layer comes before the output layer which consists of weights and biases and all the main mathematical computation takes place in this layer. In this layer, the main function that is classification takes place. These layers along with additional features like dropout and Activation function makes the model more efficient

5. System Implementation



5.1 Preprocessing

The input image captured is preprocessed by following steps. After reading the image the next step is to resize the image. The resizing of the image is vital because the images obtained from the dataset will be of different sizes which in turn would be difficult to process through the model. Therefore, we must make sure that a base size is set for all images and then fed into our AI algorithms. Then we try to remove the blur by reducing the noise. In the next step, we step we are going to segment the image, separating the background from foreground objects and we are going to further improve our segmentation with more noise removal. The preprocessing step helps to reduce the unwanted section and focuses on the main object in the image.

5.2 Feature Extraction

Features are patterns of an object in an image which will help to identify the desired result. Features include different types of properties such as corners, edges, regions of interest points, ridges, etc. This method will be most useful when the dataset is large and because of this technique it is possible to reduce the number of features without losing any important or relevant information. So, by this processing gets easier. Convolutional Neural Network will be able to extract complex features compared to Traditional feature extractors where CNN are able to express the image in much more detail and are very efficient. These large datasets have multiple different variables. These variables require high computing resources in order to process them. So, Feature extraction identifies the best feature from those big data sets thus, effectively reducing the amount of data. Ideally, these features are relatively easy to process, but still are able to describe the actual data set with the accuracy and precision. The Convolution layers and pooling layers helps us to extract features from an image. The amount of redundant data will be significantly eliminated with the help of feature extraction. In the end, the reduction of the data helps to build the model with low-cost and more efficiently and also increase the speed of learning and generalization steps in the machine learning process.

5.3 Training the Neural Network

The training set consist of n number of images stored in the database where both plants infected with disease and plants not infected with disease are present. Since this is a binary classification, we can use binary_crossentropy. The main aim of the training model is to reduce the loss and in order to achieve this we pass the optimizer parameter. There are many options that can be used. To obtain high accuracy, metric model is deployed where the parameters like number of epochs, model loaders etc. are used to make the model more precise and accurate. We pass the image(data) from the training dataset (to the model. Then calculate the loss and do a backpropagation during which we update the weights based on the loss. Then the image is fed, and the model detects whether the plant is infected with a disease or not.

5.5 Result

- Using this method, the plant disease can be identified at an early stage. The images will be processed quickly, and results can be obtained within a short span of time.
- This method mainly focuses on large databases and advance feature of color extraction that provides the better result of detection.
- The suitable prevention measures are provided to the farmers based on detection of disease.
- Training samples have been increased to improve the efficiency of disease detection.

6 Conclusion

The proposed system was developed for the welfare of the farmers and provide a boost in agricultural sector. The developed system can detect disease in plant early and help to take measures to avoid the spread of disease to other parts of the plant. By proper knowledge of the disease the remedy can be taken for improving the health of the plant This paper presents a basic overview of the concept of CNN and underlines the application of CNN in plant leaf disease detection, high accuracy, and low cost, thereby providing a more control and ease of disease detection. Moreover, it highlights the problems in older technology and puts some light on recent developments of CNN architecture in deep learning.

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