International Journal of Scientific Research in Science and Technology
Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)
doi : https://doi.org/10.32628/IJSRST52310379

Smart Farming Using Deep Learning

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ARTICLEINFO

Article History:

Accepted: 02 May 2023
Published: 24 May 2023

Publication Issue
Volume 10, Issue 3
May-June-2023

Page Number
371-378

ABSTRACT

The agricultural sector plays important role in supplying quality food and makes the greatest contribution to growing economies and populations. Agriculture is extremely important in human life. Almost 60% of the population is engaged in some kind of agriculture either directly or indirectly. Plant disease may cause significant losses in food production and eradicate diversity in species. Early of plant disease using accurate of automatic detection techniques can enhance the quality of food production and minimize economic losses. In recent years, deep learning has brought tremendous improvements in the recognition accuracy of image classification and object detection systems. Hence, in this paper, we utilized convolutional neural network (CNN)-based pre-trained models for efficient plant disease detection. The proposed method uses a convolutional neural network and deep neural network to identify and recognize crop disease symptoms effectively and accurately. This Research paper offers a through description of the DL models that are used to visualize crop diseases. In this experiment we use plant dataset, which has real time image samples of different plant, fruit, flower in different. The proposed methodology aims to develop a convolution neural network-Based strategy for detecting plant leaf, fruit, flower disease.

Keywords : Deep Learning, Pre-processing, CNN, Disease Detection, Feature Extraction

I. INTRODUCTION

Agriculture, being a substantial contributor to the world's economy, is the key source food, income, and employment. In India, as in other low- and middle-income countries, where an enormous number of farmers exist, agriculture contributes 18% of the nations income and boosts the employment rate to 53%. India is a rapidly developing nation, and agriculture is the backbone of the country's early growth. Agriculture is struggling to meet its needs as the global population grows at a rapid rate. Furthermore, knowledge of the importance of cultivation must be instilled in the minds of the younger generation. Climate change, pollinator decline, crop pests, lack of irrigation, and other factors continue to pose a threat to food security. Plant disease reduce both the quantity and quality of food produced. Plant disease not only has an effect on global food security, but they also have negative impact on small-Scale farmers whose livelihood is dependent on safe cultivation. The benefit is that plant diseases can be monitored by detecting them as soon as they appear on the plant. Identifying the state of the plant is critical for effective cultivation. Different types of environmental anomalies of the plant is critical for effective cultivation. Different types of environmental anomalies, such as fungi, water shortages, insects, and weeds, have an effect on plants. These are the kinds of issues that require farmers to take preventative steps in order to boost productivity. This research aids an concentrating on the visually targeted quality of plant. Artificial intelligence advances have made it possible to identify plant disease automatically from raw images. Deep learning in s learning identify system plant diseases automatically from raw images. Deep learning is learning system based on neural networks. One of the benefits of deep learning is that it can automatically extract features from images. During preparation, the neural network learns how to extract features. The famous deep learning model is CNN, which is a multi-layer feed-forward neural network. Although many kinds of research have been carried out using CNNs and better outcomes have been reported, there is little diversity in the datasets used. The best outcome is likely to be achieved by training the deep learning model using a large dataset. Although very good outcomes have been attained in the previous studies, improvement in the diversity of the image databases is still required. The models trained with the existing datasets lack diversity in the data and backgrounds compared to realistic photographed material obtained from real agriculture fields. In this project we take plant disease dataset. Plant datasets consist different types of leaves, flowers, and fruits in different disease classes. It contains some healthy Leaves, fruit and flowers images and some are disease affected. CNN deep- learning models are popular for image- based research.

1.1. Convolutional Neural Network

A convolutional neural network with nominal process can simply detect and categorize. It is efficient in evaluating graphical images and extract the essential features through its multi-layered structure.

As shown in fig. 1, the architecture of CNN it involves four layers, that is : input image, convolutional Layer and pooling, fully connected layer and output. Convolution Neural Networks (CNNs), it is one of the powerful techniques while working with huge amount of data and also turn out to be one of the most favoured techniques for pattern Detection. This paper contains multi-class plant leaf disease detection based on convolutional neural network (CNN).

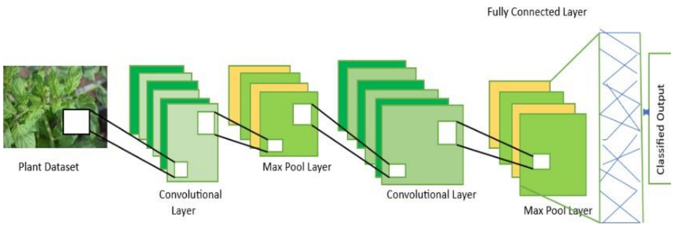


Fig 1. illustration of CNN Architecture

A. Convolutional Layer:

Convolutional layers store the output of the kernels from the previous layer which consist of weights and biases to be learned. The generated kernels that represent the data without an error is the point of the optimization function. In this layer, a sequence of mathematical processes is done to extract the feature map of the input image.

B. Pooling Layer:

This layer reduces overfitting and lowers the neuron size for the down sampling layer. This layer reduces the feature map size, reduce parameter numbers, training time, computation rate and control overfitting.

C. Activation Layer :

Utilizes a non-linear ReLU (Rectified Linear Unit) activation layer in every convolution layer. The application of dropout layers to prevent overfitting is also applied in this layer.

D. Fully Connected Layer

This layer is used to analyse the class probabilities and the output is the input of the classifier. SoftMax classifier is the well- known input classifier and recognize and classification of sugarcane diseases are applied in this layer.

II. Literature Survey

[1] Ivy Chung, Anoushka Gupta-In this paper the plants dieses are considered one of the two main causes of decreasing food availability. This paper explores not only the methods and findings of building a CNN based dieses detection model, but that of building a deployable remote crop dieses detection.

[2] Sapna Katiyar and Artika Farhana- This paper presents the survey of researches work of automation in agriculture with the support of sensors, agriculture robot and a,Mary Divya Shamili- In this paper we studied about cultivating the soil, producing crops and keeping livestock in referred to as farmers.

[7] Ashwin KS , Sebastian Cyriac- In this paper an automatic system has been developed to see whether the plant is healthy or unhealthy, if the is unhealthy then which pesticides we have to give the suggest.

[8] Rahul Kundu, Usha Chauhan, S.P.S.Chauhan,- In this paper we studied about how to capture image of plant and how to detect the dieses using image processing.

[9] Dhruvi Gosai; Binal Kaka; Dweepna Garg; Radhika Patel; Amit Ganatra- The main objective of this research is to construct one model ,which classify the healthy and diseased harvest leaves and predicts disease of plant.in this paper the Reset is used to get well result of plant diseases from the various harvest.

III.EXISTING SYSTEM

In existing system, only plants leaf disease detection are considered. The machine learning based existing methodology made out of the accompanying some state-of-the- art colour and texture features are extracted from the test image, then colour and texture features are fused together and machine learning is used for diseases classification.

IV. Proposed solution

This study is focused on the identification of plant, fruit and flowers diseases detection, treatment, and fertilizers. The segmentation, feature extraction, and classification techniques are used to detect plant diseases. Photos of leaves from various plants are taken with a digital camera or similar unit, and the images are used to classify the affected region in the leaves. To detect plant disease, we use a Convolution neural network in the proposed framework. This paper proposes a framework that employs low-cost, open- source software to achieve the task of reliably detecting plant disease.

V. Methodology

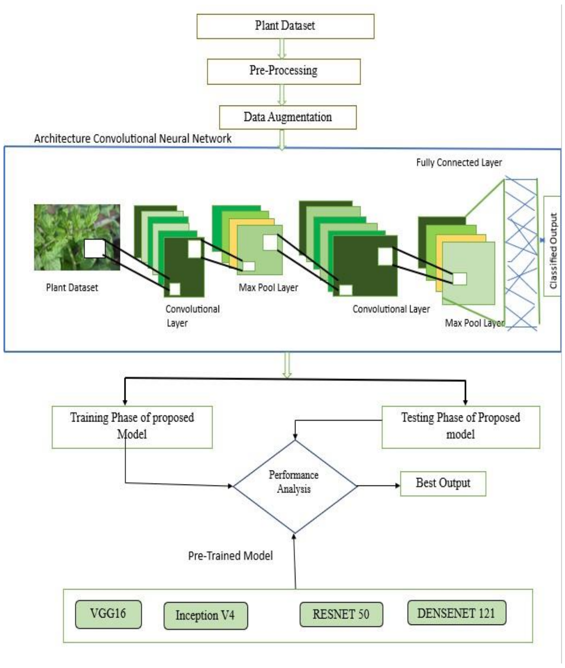


Fig 2.Overall Workflow Architecture

5.1 Load Dataset

The first step is to gather data from a database accessible repository. The image is used as the input for further processing. We've chosen the most common image so that we can accept any format as input to our method, including.bmp,.jpg, and.gif. The camera feeds the real-time images directly. Since most leaves colour varies from red to green for exact segmentation, a white background is provided for further study, proper visibility, and easy image analysis. Different images are captured using an image capturing system in this process. The picture is taken in such a way that any distortion is avoided.

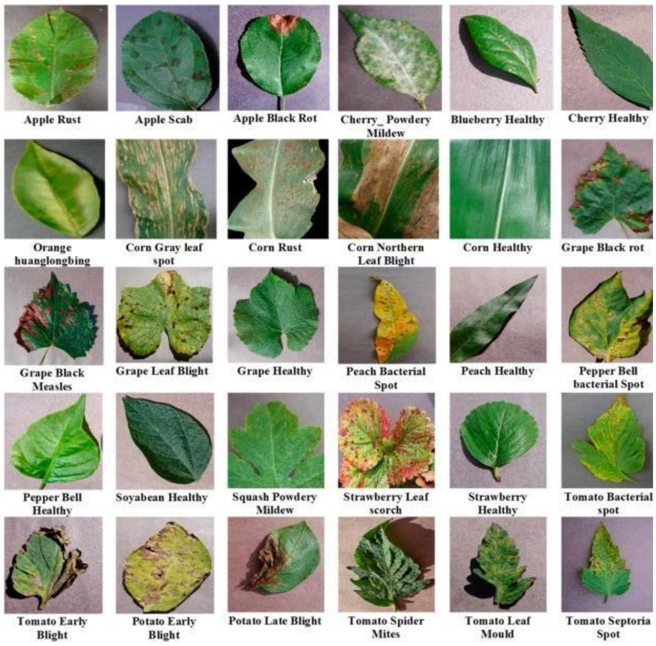


Fig 3. Sample Leaf Dataset

Fig 4. Sample Flowers Dataset

Fig 5.Sample Fruits Dataset

5.2 Image Pre-Processing

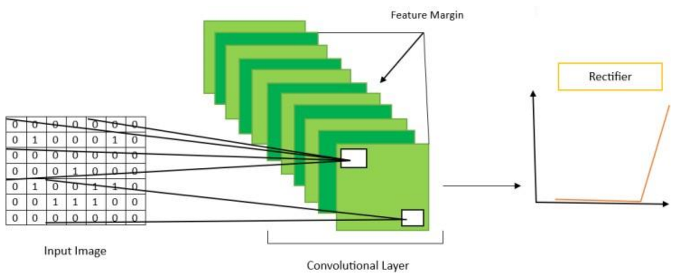
The use of computer algorithms to perform image processing on digital images is known as image pre-processing. We can detect the plant by analysing the image with a specific algorithm. We use a similar approach for image processing and detection with a specific algorithm. The image quality is critical in this process we Cannot use the algorithm if the images isn't clear. A kernel was applied to the input image matrix with the convolution process in input image matrix with the convolution process in the first convolutional layer. Then ReLu activation function was used. After passing through the activation layer, the pooling layer was applied to reduce the image size and processing power in the network on the feature map. The max- pooling method was use here.

In convolution layer for each input image, computation of Xic is performed as following.

Xic = RELU(Wi * X)

Here convolution operation have been denoted by * and Wi stands for the kernels of the convolution layer. Wi = [Wi1, Wi2, Wi3,..Wik] and K denotes the total number of convolution kernels' * M* N is a weight matrix with window size as M and number of input channels as N for each kernel. As we have non-linear saturation in our image best selection of activation function should be ReLu as it is much time faster than the other existing activation functions. ReLU is a rectified linear activation function as: ReLU (X) = max(0, X)

So in our model, We will be using ReLU.



5.3. Data Augmentation

Further, a dataset of such a size is prone to overfitting. Therefore, to overcome this, overfitting regularization techniques, such as data augmentation after pre-processing, were introduced. The augmentation processes used with the pre-processed images included clockwise and anticlockwise rotation, horizontal and vertical flipping, zoom intensity, and rescaling. The images were not duplicated but augmented during the training process, so the physical copies of the augmented images were not stored but were temporarily used in the process. This augmentation technique not only prevents the model from overfitting and model loss but also increases the robustness of the model so that, when the model is used to classify real-life plant disease images, it can classify them with better accuracy.

5.4 CNN Algorithm

CNN are based on three main components: Convolutional layers, pooling layers, and activation functions, commonly Rectified linear units(ReLUs).The number of layers used, their arrangement and the introduction of their arrangement and the introduction of other processing units vary from one architecture to another determining their specificity. CNNs consist of convolutional layers, which are sets of image filters convoluted to images or feature maps, along with other (e.g., pooling) layers. In image classification, feature maps are extracted through convolution and other processing layers repetitively and the network eventually outputs a label indicating an estimated class. Given a training dataset, CNN, unlike traditional machine learning techniques that use hand-crafted features optimizes the weights and filter parameters in the hidden layers to generate features suitable to solve the classification problem. In principle, the parameters in the network are optimized by back-propagation and gradient descent approaches to minimize the classification error. After the invention of Alex Net, along with the advances in hardware, the CNN architecture became larger. VGG-19 consists of 19 layers while Google Net has 22 layers with junctions in its architecture In LSVRC 2015, Resetnet out-performed the classification accuracy of the human- level performance with a 152 layer network.

5.5. Training and Testing Phase

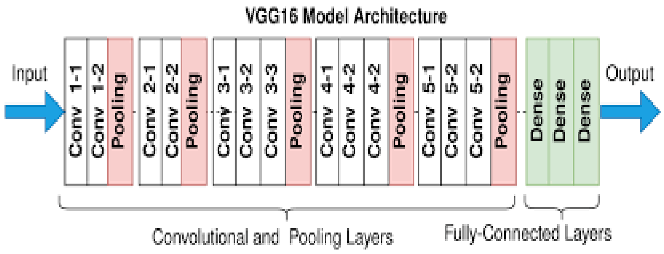
In this we use 60% data for training and 34% for testing .From that performance analysis is done and best outcome is give.

5.6 Pre-Trained Models

The pre-trained network models where chosen based on their applicability for the plant disease classification task. Each network has different filter sizes for extracting specific features from feature maps. Filters play a key role in feature extraction. Further, each filter, when convolved with the input, will extract different features from it, and the specific feature extraction from the feature maps depends on the specific values of the filters. In our experiments, we used the actual pre- trained network models with the actual combinations of convolution layers and actual filter sizes used for each network model.

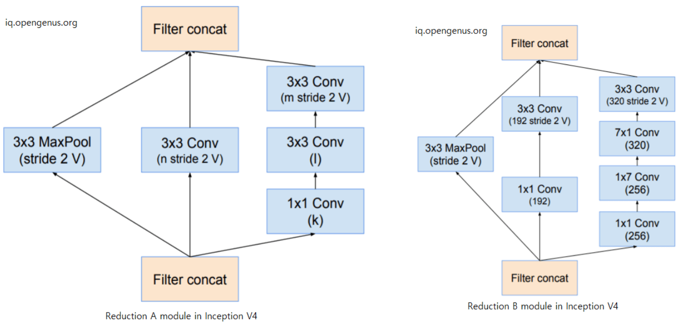
5.6.1 VGG16

VGG16 is a convolutional neural network model . The input image dimensions for the network are 224 _ 224 _ 3, and it has 64 channels in the first two layers with a filter size of 3 _ 3 and stride of 2. The next two layers in the VGG-16 have 256 channels with 3 _ 3 filters; followed by this is a max- pooling layer with stride of 2. After the pooling layer, there are two convolution layers with 256 channels with a 3 _ 3 filter size. Following the two convolution layers, there are two sets of three convolution layers, along with a pooling layer, with 3 _ 3 filters. The network includes one flatten layer, five max pool layers, and two dense layers.



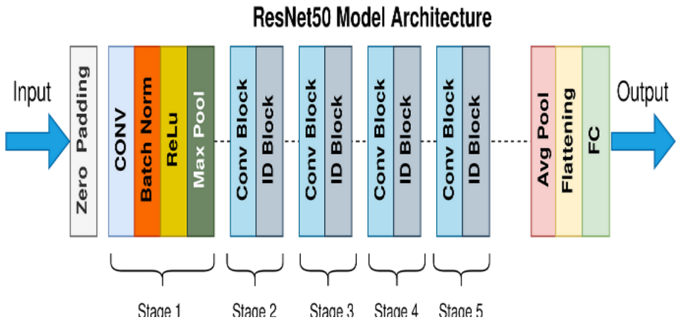
5.6.2 Inception V4

The Inception V4 block has two phases: one is for feature extraction and the other uses fully connected layers. Inception V4 includes a stem block and the Inception A, B, and C blocks, which are followed by the reduction blocks A and B and an auxiliary classifier block.



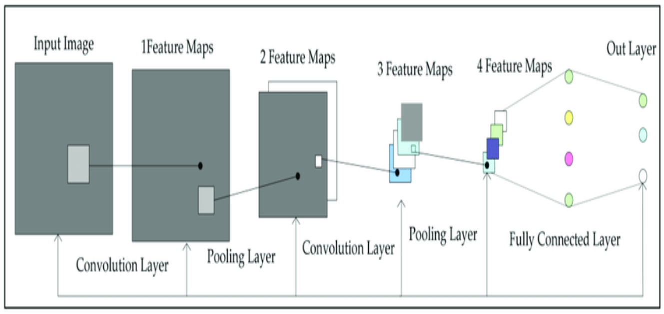
5.6.3 Resnet 50

This residual CNN network has 50 layers, and the first layer is a convolutional layer with kernel size 7 _ 7, a stride of 2, and 64 channels. The next three stages are convolution layers with filter sizes of 1 _ 1, 3 _ 3, and 1 _ 1 and 64, 64, 256 channels. These are repeated three times. Similarly, the next convolution layers are repeated four times and the subsequent convolutional blocks are repeated six times.



5.6.4 DENSENET 121

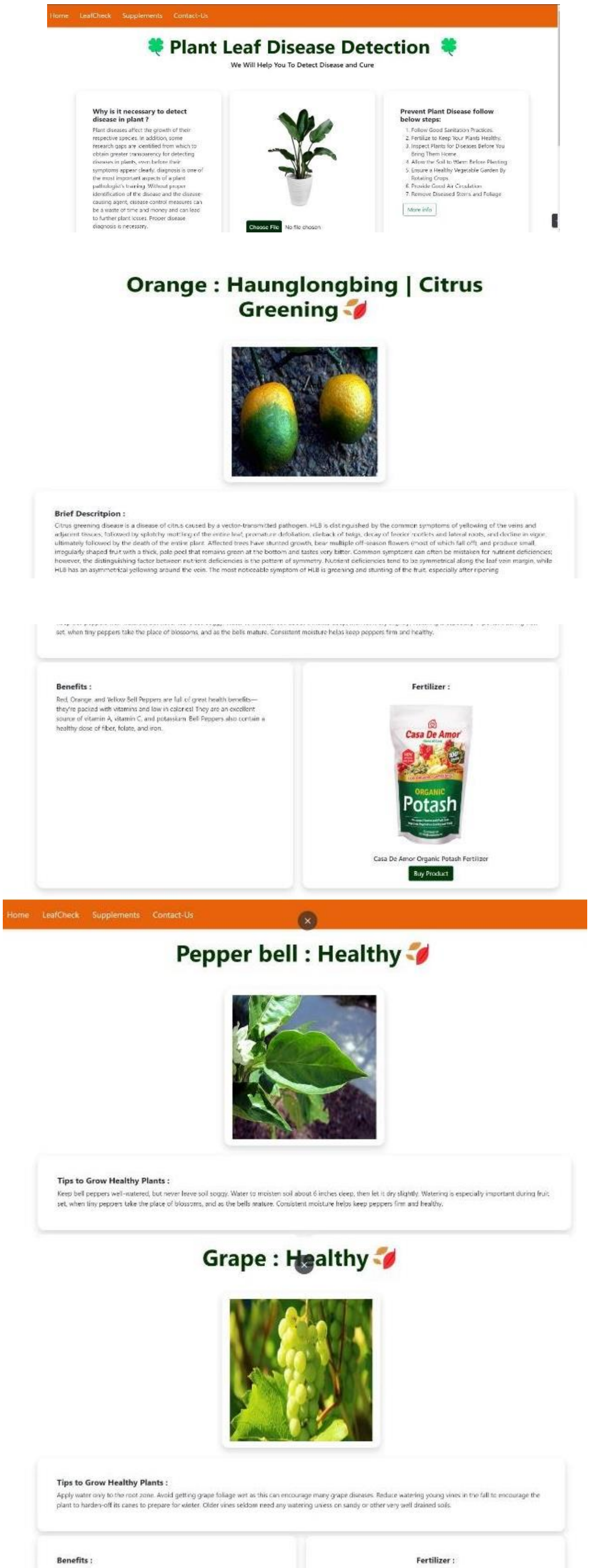
DenseNet-121 increases the depth of the convolutional neural network by solving the vanishing gradient issues. It has four dense blocks. In the first dense block, convolution is performed with 1 _ 1 and 3 _ 3 filter sizes, and this is repeated six times. Similarly, in the second dense block, convolution is performed using the filter sizes 3 _ 3 and 1 _ 1 and the steps are repeated 12 times. In the third dense block, convolution operations with the same filter size are repeated 24 times, and in the fourth dense block, the steps are repeated 16 times. In between the dense blocks are transition blocks with convolution and pooling layers.



VI. RESULT

Hence, in this work, we evaluated four pre- trained models—VGG-16, ResNet-50, Inception V4, and DenseNet-121—to determine the model that was best capable of classifying various plant diseases. In this project we use plant, flowers and fruits to detect the disease. In this project we create one web application which is used to capture the image and predict the disease and give the its treatment, pesticides etc. We first store the all type of leaf, flowers, fruit disease.

When we click the photos it capture the image and compare with disease which is we stored in the database.



VII. CONCLUSION

The proposed system tracks the crop field on a regular basis. The CNN algorithms is used to identify plants ,fruits and flowers diseases at an early stage. Deep learning methods are used to detect the model, which aids in making appropriate disease decisions. To contain infected diseases, the farmer is advised to use pesticides and fertilizers as a cure. This paper presents a review of various disease classification strategies for plant, fruits, flowers disease detection. From the performance analysis of the various pre-trained architectures, it was found that DenseNet-121 outperformed ResNet-50, VGG-16, and Inception V4. Training the DenseNet-121 model seemed to be easy, as it had a smaller number of trainable parameters with reduced computational complexity. Hence, DenseNet-121 is more suitable for plant disease identification when there is a new plant disease that needs to be included in the model, demonstrating reduced training complexity.

In the future, the proposed scheme could be expanded to provide additional facilities such as nearby government markets, pesticide price lists, and a nearby open market, among others. And also, we use more plant, fruit and flowers images. Furthermore, we are working towards implementing a mobile application with the trained model from this work.

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Cite this article as :

Pravin Patil, Parvati Tadval, Rutuja Tanpure, Pruthviraj Yamgar, Sudarshan Zarkar, "Smart Farming Using Deep Learning", International Journal of Scientific Research in Science and Technology (IJSRST), Online ISSN : 2395-602X, Print ISSN : 2395-6011, Volume 10 Issue 3, pp. 371-378, May-June 2023. Available at doi : https://doi.org/10.32628/IJSRST52310379

Journal URL : https://ijsrst.com/IJSRST52310379