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PLANT LEAF DISEASE DETECTION

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Abstract: Early detection of plant disease is important for agriculture for the effective production and also to improve the economy of the country. Automatic detection and classification of plant disease and providing required remedy proves to be one of the efficient technique for agriculture. This paper presents one of the computer vision technique, a convolutional neural network(CNN) with the transfer learning method for effective classification of diseases in 3 crops namely Capsicum, Potato and Strawberry. The above technique effectively provides an accuracy of 95%.
Keywords: Convolutional Neural Network(CNN), Computer vision, classification, transfer learning.

I. INTRODUCTION

Agriculture is the art and science of cultivating plants and livestock. It is one of the major sectors of the Indian economy as it contributes about 18% to the total GDP and provides employment to over 60% of the population and is present in the country for thousands of years. Over 75 per cent of the rural households depend on agriculture. Nowadays there is a tremendous loss in quality and quantity of food crops yield because of various diseases affecting the plant. For this purpose proper steps should be taken to rescue the plants from disease and to increase the yield. Early detection of these diseases can allow to take preventive measures and mitigate economic and production losses. A leaf is one of the most important part of a plant responsible for photosynthesis. So, detecting the disease through leaf will be one of the primary sectors in finding the disease.

So the objective of this work is to develop a software, that is effective and error-free disease detection system for plant. To overcome the leaf disease, a software in been developed particularly for three species i.e., Potato, Capsicum and Strawberry which automatically detect the disease using the image of the leaf and also provide the remedies for those diseases

II. PROBLEM STATEMENT

One of the important sectors of Indian Economy is Agriculture. Employment to almost 55% of the countries workforce is provided by Indian agriculture sector. India is one of the largest producer of pulses, rice, wheat, spices and spice products. Farmer's economic growth mostly depends on the quality of the products that they produce, which in turn mostly relies on the plant's growth and the yield they get. Therefore, for the better yield in agriculture, detection of disease in plants plays an instrumental role. Plants are highly prone to diseases that affect the growth of the plant which in turn affects the profit of the farmer. In order to detect a plant disease at very initial stage and to avoid its spread, use of automatic disease detection technique is advantageous. The symptoms of plant diseases are commonly found on the leaf of the plants. Manual detection of plant disease using leaf images with the help of experts is a tedious job. Hence, it is required to develop computational methods which will make the process of disease detection and classification using leaf images automatically for better yield and profit for the farmers.

III. EXISTING SYSTEM

In India, farmers still uses the traditional method to detect the diseases in the leaf. Farmers or experts uses their naked eye observation to find the disease .This how the identification and detection of leaf diseases is done. So in order to do this work, a team of knowledge person as well as a continuous monitoring of plant is necessary, which costs very high when we do with large farms and it can be done to the limited area. But in few countries, farmers do not have proper facilities or even idea that they could contact to experts. And also consulting experts even isn't a cost friendly as well as it is not time consuming. In such conditions, Automatic detection of the diseases by just seeing the symptoms on the plant leaves makes it easier as well as cheaper. Whereas if automatic detection technique is used it will take less efforts, less time and gives more accuracy. In plants, some general diseases seen are brown and yellow spots, early and late scorch, and others are fungal, viral and bacterial diseases. Image processing is used for measuring affected area of disease and to determine the affected area.

IV. PROPOSED SYSTEM

The proposed system makes use of one of the deep learning technique called the Convolutional Neural Network(CNN). CNN are mainly used for classification problems. The proposed system involves transfer learning methodology i.e., using one of the pre-trained architecture to get better results. VGG19 is used as the transfer learning architecture which is composed of 19 deep layers. The system takes in an image of a leaf as an input through the device camera or its internal storage and goes through three level of classification described below:

- Healthy/Unhealthy(proceeds further if classified as unhealthy)
- Classification of the Crop
- Disease classification

Once the disease is been finally classified its related description about the disease and its corresponding remedies are provided in order to prevent the further spread of the disease. The proposed system is capable of identifying the diseases such as pepper bell bacterial spot, potato early

blight, potato late blight, strawberry leaf scorch including their healthy images of each crops.

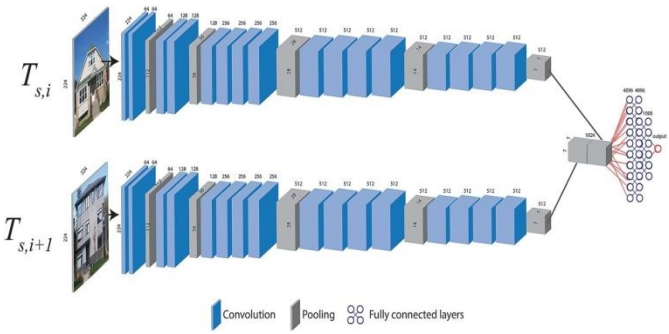
IV. METHODOLOGY

Convolutional Neural Network: (CNN) is a Deep Learning algorithm which can take in an input image, and process them to classify the given image. The pre-processing required in a CNN is much lower as compared to other algorithms and Image Processing techniques. CNN is capable of applying many filters automatically It mainly consist of four layers:

- Convolution layer: In this layer series of mathematical operations are performed to extract the feature map of the input image.
- Pooling layer: It is mainly used to reduce the size of the output matrix from the convolution layer. There are 3 different types of pooling: Max, Min, Average pooling.
- Flattening layer: is converting the data into a 1-dimensional array for inputting it to the next layer. The output from the convolutional layers are flattened to get a single feature vector.
- Fully connected layer: The output from the flattening layer is fed into the fully connected layer. Recognition and classification is performed in this layer.

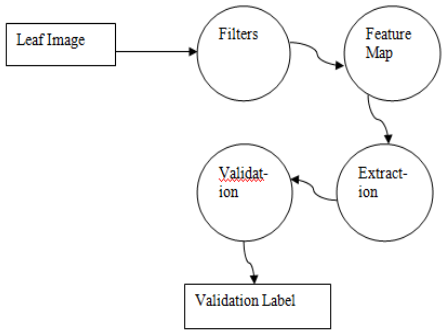
The system uses transfer learning technique i.e., VGG19 model has described below

- VGG19 is a variant of VGG model which in short consists of 19 layers that includes 16 convolution layers, 3 Fully connected layer, 5 MaxPool layers and 1 SoftMax layer. There are other variants of VGG like VGG11, VGG16 and others.
- A fixed size of (224 * 224) RGB image was given as input to this network which means that the matrix was of shape (224,224,3).
- They subtracted the mean RGB value from each pixel, which was the only preprocessing which was done and computed over the whole training set.
- Used kernels of (3 * 3) size with a stride size of 1 pixel, this enabled them to cover the whole notion of the image.
- Spatial padding was used to preserve the spatial resolution of the image.
- Max pooling was performed over a 2 * 2 pixel windows with stride 2.
- This was followed by Rectified linear unit(ReLu) to introduce non-linearity to make the model classify better and to improve computational time as the previous
- models used tanh or sigmoid functions this proved much better than those.
- It was constructed with three fully connected layers from which first two were of size 4096 and the next layer with 1000 channels for 1000-way ILSVRC classification and the final layer is a softmax function.

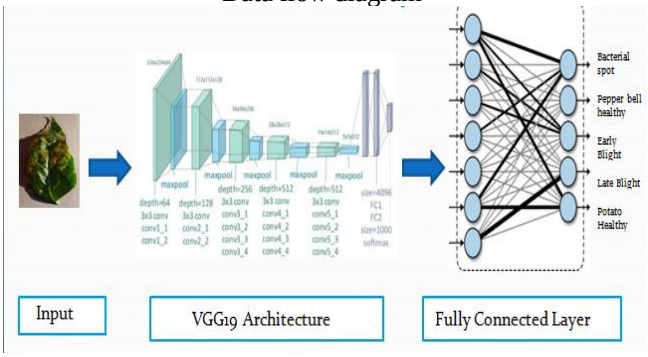


VGG19 Architecture

We have used plant village dataset consisting of 3 crops namely Pepper bell, Strawberry, Potato. The dataset is divided into 80% train and 20%test.5124 images were used to train the model and 1226 images for testing. The images selected from dataset is cropped to the size of 224X224 each input image matrix is been convoluted and reLU activation function is been applied. The fully connected of VGG19 is modified as per our project requirements. The fully connected layer is composed of 2 hidden layers consisting of 512 and 256 neurons respectively, Adam is used as optimizer as it converges fast and a batch size of 32 was used during training of the model. The output layer is multi neuron output which gives out the final results. The system consists of 3 levels of classification. At the first stage the given leaf input is classified to be healthy or unhealthy, if the result is classified at healthy the further processing is not done else the image is passed to the second level of classification where the type of crop is identified at the last stage of classification. The final disease have been outputted. Based on the type of disease identified the remedies for the same is given out.



Data flow diagram

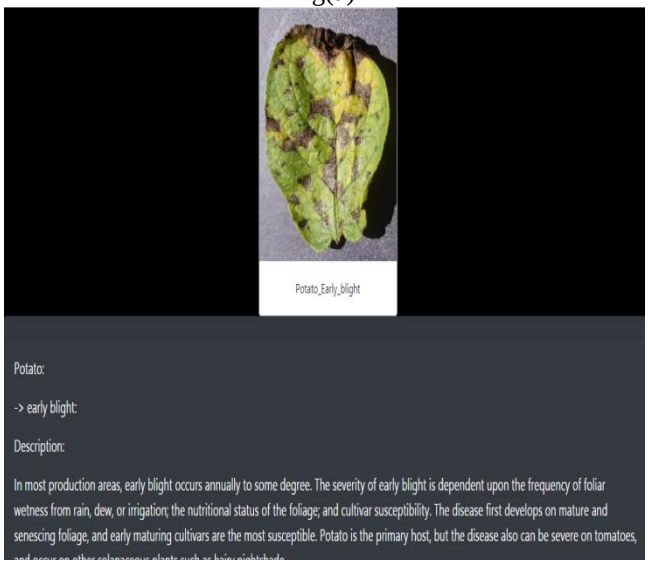


System Architecture

V. EXPERIMENTAL RESULTS

The snapshots of the results are shown below. The system is capable of detecting the diseases with 95% accuracy. If the system is given with the crop that is not trained it will show a message stating that the given crop was not trained. The Fig(a) shows the three level classification for an given potato leaf as input. Fig(b) shows the description and remedy associated with that disease. Fig(c) shows first level of classification since it is a healthy image.

Fig(a)



Fig(b)

Fig(c)

VI. CONCLUSION

Detection of the plant disease at its early stages proves to be one of the best method to avoid the spread of the disease further hence, we have come with the system that automatically detects the disease affected to a plant with the help of the leaf image. The symptoms of the disease appears on the leaf region and hence taken as an input for further detection and classification. These images are classified using CNN and transfer learning methods by using VGG19 architecture. The system is capable of finding disease with 95% accuracy. And shows three level classification if it is detected as unhealthy and one level of classification if it's healthy.

VII. FUTURE SCOPE

In future the same technique can be extended to multiple crops to detect more number of diseases. Also many other deep learning technique can be used to enhance the accuracy. More number of dataset can be used to get better results.

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