Study on stages of diseases detection in plant using Deep Convolutional Neural Network (CNN) in Agriculture

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Abstract: Deep learning nowadays shows a drastic result by applying many techniques such as CNN (Convolutional Neural Networks). Labelling an image in various detecting technique such a object, face recognition, handwriting and so on is a various process to identify the exact partition of efficient results. The experience of agriculture phenomena brings a various impact on increasing the productivity by avoiding erosion, air pollution, pesticide resistance and so on. When plan diseases are fed as image to investigate the classification of affected biotic and abiotic crops from the field. Eventually the essential prediction of automatic and better results of removal of noise by applying chain rule a deep neural chain structure describe the betterment of efficiency by detecting the affected part. Previous works using machine learning and deep learning lacked in visualisation of affected part of leaves in agriculture. By applying convolution Neural Network on image recognition several steps such as segmentation, selection, activation function and feature extraction helps to get accuracy compare to other image processing techniques.

Keywords: Classifier, Convolutional Neural Networks, Deep Learning, Supervised Learning

1. Introduction

Agriculture plays significant impact in everyday life to all living organism in the world. The growth in technologies of modern world has made the huge population of the whole world to meet their food demands in an effective way [1]. Security of food is frightened by several factors including change in climate, pollinators rejection, diseases caused in plants and so on [2]. Diseases occurring in plants remain as a threat not only to the global market but also remains to frighten the farmers who own in decreased land levels also as their income is based on mainly the crops they cultivated [3][4]. Such farmers contribute to more to the production yield from agriculture as well as loss occurs mainly due to the plant diseases. According to reports, these category of farmers only contribute people who have been supplied with less amount of food[5].

Several steps are in progress to prevent the loss of crops that occurs because of diseases. The disease affecting crops have to be identified in the initial stages to prevent reduction in crop production as well as to manage diseases in an effective way.

Clinics connected with plants help in identification of diseases affecting plants are associated with several organizations related to agriculture. The extension of help to disease management is also done by several other usage of technology and has also been made online nowadays with the revolution in the internet industry. Mobile phone tools have also helped in such cases to deal with farmers issue [6].

Mobile phones help in detecting the diseases in a smart way as it has several advanced features such as power to compute the works, display with good resolution as well as accessories like camera display. The usage of smart phone increases day by day and has reached a rapid increase in the global market. These factors along with the features of mobile phones (cameras) has made the recognition of images automatically possible. Deep learning method is used and representation of plant with their respective diseases have also been discussed in several existing works.

1.1 Research discussions in plant diseases using Deep Learning

Image processing is the major domain where the idea behind the processing of input data as images always differs. Considering the latest technologies such as machine learning and deep learning travel towards many techniques such as deep belief networks(DBN), Recurrent Neural Network(RNN), Gradient Descent Algorithm etc for processing the accuracy of image, the most important to visualize the overview of image data we are tracking the concept called Convolutional Neural Network(CNN). This model more over used in all concepts and problems we narrow down the architecture to focus on Visualization of any image data as input from dataset or raw image directly taken from field. Now we will discuss the various Deep learning models are used to automate the detection of diseases in plant.

Table 1. Deep Convolutional Neural Network (CNN) Architecture along With Various Model with Its Categories

S.No	Name of the Model	Year Proposed	Data set trained on	Deep CNN Categories	No.of Layers	Activation Function

1	LeNet-5	1998	MINST	Spatial Exploitation Based CNNs	6	TANH
2	AlexNet	2012	CIFAR & NORB	Spatial Exploitation Based CNNs	8	ReLU
3	ZFNet	2013	ILSVRC	Spatial Exploitation Based CNNs	5	ReLU
4	Inception-v1/GoogLeNet	2014	ImageNet	Depth based CNNs	9	ReLU
5	ResNet-50	2015	ImageNet	Multi-path Based CNNS	50	ReLU
6	Inception-ResNets	2016	ImageNet	Depth based CNNs	164	Softmax
7	ResNeXt-50	2017	Cat-Dog Dataset	Multi-path Based CNNS	152	Relu
8	Channel Boosted CNN	2018	Orange,Telecom	Channel Boosted CNN using TL	3	ReLU

Alexnet Architecture Applied on Plant Disease Dataset

Even compared to LeNet the CNN model Alex NET was not better performer when images are classified as dataset.

Image recognition and classification involved Alexnet mostly. When different parameters are applied for performing optimizations the size of the hardware becomes a major issues. So CPU performance takes much time and restricted with its less size. SO GPU NVIDIA GTX 580 can support to overcome the issues. Moreover all 8 layers in CNN based Alex architecture are dealing with resolution of images and cannot avoid the over fitting problem. A non-reliability issues are also arising when there is fitting image problem. To improvise the convergence rate in the Gradient based learning large size filters were used and FC3 (fully connected layer was achieved in the image data's as output. So the affected parts of plant as a disease can be applied on CNN architecture Alex NET and achieve the 5 convolutional layers with 11* 11 as first step, 5*5 as convolution2, pooling 3, 3*3 Convolution3, pooling 2nd level, 3*3 convolution 4, similarly convolution 5. pooling 3, fully connected layer 1,2 and 3 and loss rate can be reduced and performance on accuracy can be achieved

Examples such as moving car, objects in image, video buffering deals with object detection where CNN plays a vital role. Image recognition as a object recognized in our plant disease prediction are handled by SIFT, HoG, SURF etc. The major difference when compared to machine learning that was handled before deep learning was single crop usage as input in identification of labels in single class. When machine learning has less feature extraction and classified with its single image which shows the less process of sample since it has taken prediction of label from less data's feature extracted.

Recognition of images [7][8] to identify plant diseases has made tremendous growth in recent years. Classification of objects to solve problems can be performed in an easier way by the benchmark set by the existing organizations. Neural networks training is an excellent process but at the same time it consumes more time but on the other hand they can be used in mobile phones where images can be classified in a faster manner.

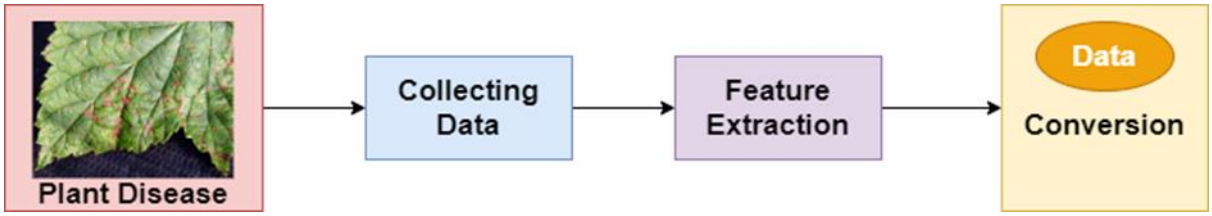

Fig.1. Collection of Data and Feature Extraction

There are many architecture model such as VGG16, ResNet50, InceptionResNetV2 which are the most accuracy providing model on Imagenet data's.

Fig.2. Data Preprocessing

In the process of learning neural networks have played an important role as it mainly helps to map the infected plant image acting as input along with the pair with crop and disease as the output. Neural Network nodes uses edges associated with input and also with the edges associated with output. Both the input and output are in numerical form [9]. This clearly depicts that there is a mapping between both the input as well as output layer with several other layers in between them. The main aim is to construct a network deeply to map the respective input with the corresponding output. Parameters of the network are also taken into account as this may improve the process of mapping in the phase of training. The above said process is one of the significant challenges faced in modern times that has been tried to be solved by several improvements in engineering process.

The main aim of classifiers is to detect the plant disease necessitates the need of a huge dataset with images of both diseased as well as non-diseased plants. It was difficult to obtain such large datasets and were all available only for paid users. In order to face such problems, few organizations have worked towards it and made those datasets to be available for free access. Several images were incorporated in the model to identify the disease associated with each crop respectively with the help on CNN (Convolutional Neural Network approach). Also the feasibility test is performed based on the ability to predict the disease in the crop with the help of smart phones.

Living organisms are responsible for attacking plants and such organisms are referred as biotic [10][11]. On the other hand, abiotic organisms are non-living factors that cause disease in plants. Fig.3 shows the depiction of biotic as well as abiotic.

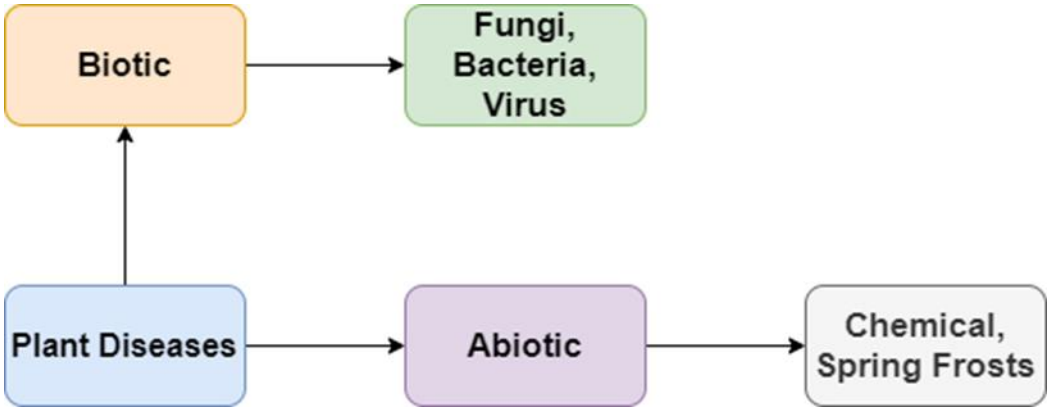

Fig.3. Biotic Vs Abiotic

1.2 Issues in agriculture

Technology such as wearable devices and mobile phones, ipad, tablets etc deals a major changes in each field which we focus on Crop diseases [12]. IOT devices such as Raspberry pi, Ardinuo are mainly used to monitor in the agriculture field and identify the diseases that are spreading to plants in different aspects. Crops sample have been taken and various diseases such as aster yellows, bacterial wilt, ice bacterial blight, scab are identified as various issues and it can be deal with various techniques such as machine learning, computer vision and deep learning.

One of the deepest training model are considered using Image input to detect the disease [13]. Even pesticides such as neem oil spray, herbal water are used in natural insecticides plants face many diseases. Section 2 discusses about the system used to detect plant disease. Section 3 discusses the existing systems limitations and Section 4 concludes the paper.

2. Recognition System

Plant disease identification includes several steps and are discussed in the following sections.

2.1 Phases in identification of plant disease

In general deep learning has always two process to handle with image data set using Convolutional Neural Network(CNN).They are training and testing model. Accuracy of the plant diseases with various images of leaves may produce different results as mentioned in frontier results may take 20% of testing and 80% of training of same sample of leaves, whereas the precision mean and recall keeps varying according to the time interval of all the time range changes [14].

The system used to identify plant disease operates in two main phases namely training as well as testing phase [15][16]. The training phase again is sub-divided into further phases such as taking an image from the leaf, segmenting the interested regions, extracting features followed by the classifier training. The major step in testing phase is identification of image as infected leaf or not.

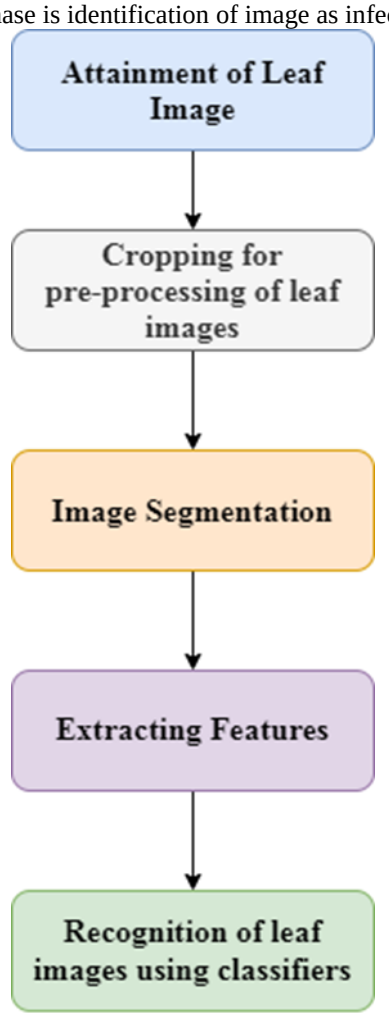

Fig.4. Steps in Recognition of disease in Plants

2.2 Attainment of Leaf Image

As sample from 54,306 images of plant leaves are collected for research process and with that various set of labels part as class are listed in 38 numbers. Images are fed into training model as Deep learning refers the Convolutional Neural Network, Deep Neural Network which has better optimization, as well label prediction are results in good performance. As the datasets are comparatively high in number the images can face a major issue called over fitting since training model are over done and epoch is highly increased [17].

2.3 Cropping for pre-processing of leaf images

Plant disease is mainly identified when detection takes place for environmental circumstances. Parts of infection that are caused are including the bacteria virus, viriods parasitic plants and so on. A frequent change in the growth of plants and its development changes are due to the causes and effects of disease [18]. Major changes

are colour change which human eyes cannot spot and its reflectance information that can be identified as changes in plant so called spatial resolution. Images whose background remains to be complex need cropping techniques that can be performed either manual or with the help of functions in an automatic manner.

2.4 Image Segmentation

Images that are segmented help in identifying the infected places in an easier manner with many available techniques as well as methods. Sobel operators as well as edge based systems were used by few existing systems. The above mentioned systems are based on edges. Few other systems based on threshold such as entropy based methods are also prevalent along with methods where the threshold is set manually that helps to segment affected part easily. Due to color differences in the leaf, segmentation methods based on colors were also carried on. In case of clustering methods, k-means algorithm produced better results than the edge based detection methods. On the other hand, k-mediods suffered from the disadvantage of handling noise [19]. K-means algorithm in combination with many other methods produced effective results with certain limitations. Finding of threshold value stands an important step in segmenting the images.

2.5 Extracting Features

CNN is one of the important techniques which an image of affected leaves from plant is taken into account and pass as input layer via a multiple layers of identified neurons. All the individual layers understand the additional features of the image which is passed as input. Using mathematical calculations the network convnet architectures differentiate the multiple layers that are connected and interconnected after its separated from each neurons. From that network established many hidden neural network also are layered as pixel values, identification of edges, interconnection of edges, identified matching features and again joined common features are listed [20]. When leaf is fed into convnet, all assigned neurons that change pixels and converts signal to next layer that helps the next multiple layer to understand the chain structure. Thus the exact feature is identified and processed.

2.6 Recognition of leaf images using classifiers

The main purpose of a classifier is to recognize an image of leaf and classify it as affected or not. The classifiers are further divided as supervised and unsupervised learning methods. Some of the predominate methods in literature have been depicted in the fig. The input for supervised methods are labelled images whereas unlabelled images serve as inputs for unsupervised learning [21][22]. With these inputs the model is able to learn and predict the output as whether the image fed into the model is affected by disease or not.

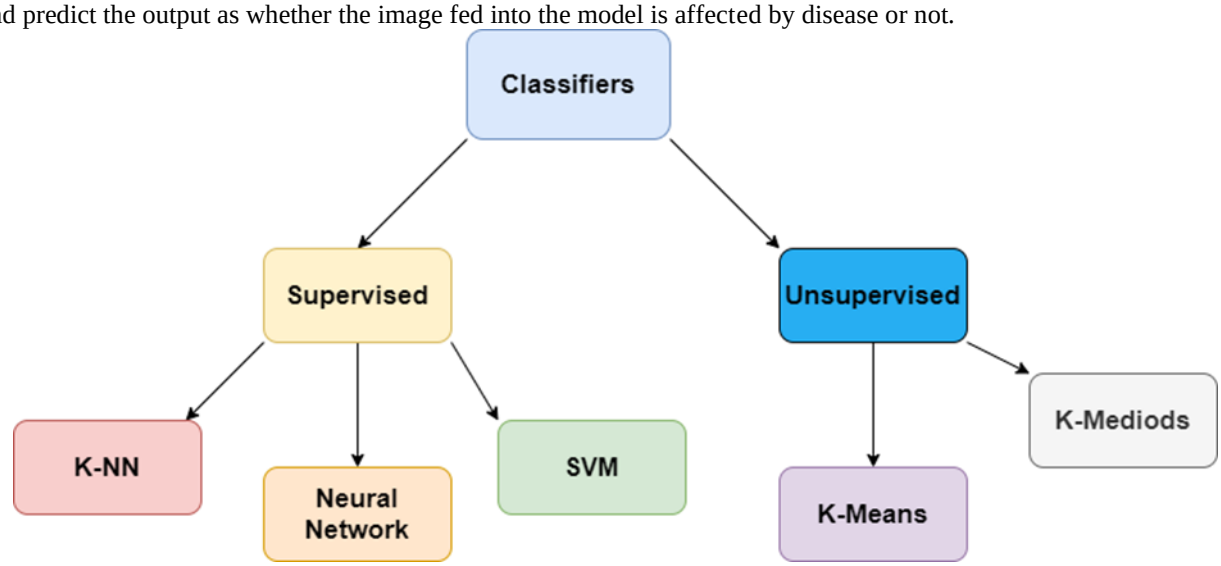

Fig.5 Classifiers in detecting plant disease

3. Discussion

Imaging methods used to detect the defected plant were found with certain limitations such as lack of good training dataset. Existing system suffered from such limitation by making a good training dataset as q requirement as it may result in overfitted models when remain unnoticed. Scenarios like these need to be handled by introducing hybrid methods or techniques that can work well in all environments. Research in depth has lead to focus on CNN methods to predict diseases in plants in a better way.

4. Conclusion and Future Scope

Automation of plant disease identification is an important step to recognize the affected plants. Manual entry of data doesn't produce much results when the dataset size increases. Our survey shows all the techniques used in identification process as well as makes it a research focus area. In case of detecting disease in the plant it is very much important to know the stage of disease as whether it is in the starting or advanced stage. Also the amount of chemicals applied to recovery should also be taken into account. Introducing many applications to

identify the plant disease as well as automatic report generation can also be a breakthrough in this field. Another aspect to be noted is maintaining high accuracy level which is a difficult task. Our proposed system will overcome all the above-mentioned difficulties and also predicts diseases automatically among huge datasets.

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