

Study of Different Disease in Potato and their Detection Technique Using Leaf Image

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Abstract- This paper holds a survey on various technique of disease detection through leaf images. Digital image processing is fast, reliable and accurate technique for detection of diseases; various algorithms are also used for identification and classification of leaf diseases in plant. This paper presents techniques employed by different author to identify disease like machine learning, deep learning, artificial neural network, image processing. The foremost focus of this paper is to go looking various techniques to identify disease. Disease during a crop ends up in small efficiency and successively ends up in huge damage to the agronomists. Thus, recognition of disease in initial phase are going to be helpful for agronomist in order that essential actions will be taken. This paper discusses machine learning techniques to detect the disease within the plant with the assistance of the image of the plant. Accurate plant diagnosis requires experts' knowledge but is typically expensive and time consuming. Therefore, it's become necessary to style an accurate, easy, and low-cost automated diagnostic system for plant diseases. This paper present survey on different classification techniques that may be used for plant disease classification. A classification may be a technique where leaf is classed supported its different morphological features. There is such a large amount of classification techniques like k-mean clustering, Support Vector Machine.

Index terms- Back Propagation, Image Processing, KNN, K- Nearest, Leaf diseases, SVM, Machine Learning

I.INTRODUCTION

India is agronomic country and maximum of individuals depends on agronomy. Farmers have big range of collection in Fruit and Vegetable crops. The agriculture may be improved by technical support. In most of the cases diseases are seen on the leaves, fruits and stems of the plant, hence detection of disease plays a vital role in successful agriculture of

crops. In most of cases plant diseases are caused by pathogens, microorganism, fungi, bacteria, viruses, etc. Sometimes unhealthy environment include soil and water is additionally to blame for diseases in plants [1].

Since the traditional times agriculture has its own importance in human life. Plants are the fundamental source for supply of energy for human. Productions supported agriculture get easily tormented by various plant diseases. These diseases cost as social, ecological and economical loss to farmers. It becomes important to research plant diseases very accurately within specific time. Some diseases are visible to human eyes and may be easily detected and procured. Some are so sophisticated needs powerful microscopes or specific spectrum. Digital technology can make it very easy task to process all quite disease images very precisely. It also gives the power to remote sense the diseases without having an expert on the sector.

Plants play a really important role in human life. Plants have verity of uses as food, medication, raw materials and maintaining a balance ecosystem. Plant diseases are generally caused by pest, insects, pathogens and reduce the productivity to large scale if it's not controlled on time. Agriculturists face lose due to varies crop disease. one in all the important sectors of Indian Economy is Agriculture. Employment to almost 50% of the countries workforce is provided by Indian agriculture sector. Farmer's economic process depends on the standard of the products that they produce, which relies on the plant's growth and also the yield they get. Therefore, in field of agriculture, detection of disease in plants plays a participant role. Plants are highly at risk of diseases that affect the expansion of the plant which successively affects the ecology of the farmer. so as to detect a disease at very initial stage, use of

automatic disease detection technique is advantageous. The symptoms of plant diseases are conspicuous in numerous parts of a plant like leaves, etc. Manual detection of disease using leaf images could be a tedious job. Hence, it's required to develop computational methods which can make the method of disease detection and classification using leaf images automatic.

Deep Learning technology can accurately detect presence of pests and disease within the farms. Upon this Machine learning algorithm CART can even predict accurately the possibility of any disease and pest attacks in future. a standard human monitoring cannot accurately predict the number and intense of pests and disease attacked in farm for spraying correct and enough fertilizers/pesticides to eliminate the host. Therefore, and artificial Perceptron tells the accurate value and provides corrective measure of amount of pesticides/fertilizers to be sprayed at specified target areas. This help the farmers to guard his farm from any quite pests and disease attacks and eliminate them without disturbing the decorum of the soil and untouched parts of other plants. Mostly in India farmers use manual monitoring and a few apps which have huge database limitations and are only guaranteed to detection part. Since, Prevention is best than cure, our aims is predicting attack of pests/diseases in future thereby making farmer to forestall such attacks [2].

Technology has dived into depths in agriculture sector. Automation technology is that this most demanded tool in agriculture. Many companies have come up with latest solutions in Machine Learning, AI transforming agriculture into a Digital Agriculture. Many tests have proved that deploying technology in farms, will increase crop yield and farmer's revenue thereby. In this paper, several researches associated with various plant leaf diseases detection using different classification algorithms are reviewed [3].

II. LITERATURE REVIEW

The method proposed by Monzurul Islam, Anh Dinh, Khan Wahid and Pankaj Bhowmik in 2017 [4] present an approach that integrates image processing and machine learning to allow diagnosing diseases in Potato plant from leaf images. They collect the database of the potato leaf from publicly available

plant image "Plant Village" and classifies diseases through SVM classifier. In their research they detect the disease called late blight and early blight. As leaf have some visible symptom on the plants, particular on leaves, so disease detection can be performed by imaging analysis of those visible pattern on leaves, thus they combine imaging technique with machine learning. At first segmentation perform on leaf images, mask out the background as well as the green region of the leaves. Thus, extract region of interest (ROI) that only contain visible disease symptoms by training a multiclass SVM classifier with these properties detect and distinguish the disease. Chose a technique based on a set of masks generated by analysis of the color of luminosity components of different regions of the images in $L^*a^*b^*$ color spaces. As the region containing diseases symptom has significant difference in color and texture then the surrounding region and try to isolate them. Then extract the leaf only images by masking of the background, and determine threshold for L^* , a^* and b^* channel that will segment the leaf from the background. The threshold range selection for channel L^* , a^* and b^* from histogram analysis then extract the feature from leaf images of the dataset and for that co-occurrence Matrix (GLCM) was used and besides, numerical indicators like mean, standard deviation, entropy, skew and energy were calculated from the histogram, classification done by SVM and at last accuracy, sensitivity, recall and F1- Score were calculated. The future work of this research is to automatically estimating the severity of the detected disease.

Method proposed by Pridarshani Patil in 2017 [5] for present efficient automated disease management technique in potato. The images of potato leaf are captured and analyzed to detect disease symptoms and classified by the use of image processing and machine learning technique. Their system has five modules i) dataset ii) preprocessing iii) clustering iv) feature extraction v) classification. Pre- processing in applied to all images of dataset by rescaling and conversion to HSV color space. Then training images are subjected to cluster. analysis using FCM and texture features are extracted. The texture feature extracted are used for classification. The classification results detect and categories if leaf image is disease affected or normal. SVM, RF and ANN used for classification. Project is implemented

in open-cv and python. It concluded that ANN is best classifier with highest accuracy of 92%.

Manya Afonso, Pieter M. Blok, in 2018 [6] proposed a method for detect disease in potato plant name blackleg. Deep learning was used for detecting blackleg through two deep convolutional neural network that were trained on RGB images with healthy and diseased plants. The subset of images was randomly split into a training and testing set. Further the test set was used for independent benchmarking of the CNN classifier. PyTorch framework was used to code the CNN classifier in Python. Two residual architecture were trained, one with 18 layers and one with 50 layers. The evaluation was performed on the test set. For each test image, the decision healthy or blackleg diseased was decided through majority voting over the 5 trained models of each network. The evaluation of the classifier was done by the use of confusion matrix it showed the breakdown of true healthy and true blackleg diseased images. Recall and precision were also calculated by the confusion matrix. Their research worked as a robust detector for blackleg disease in potato. In future research it can be extend with CNN as an object detector. Future work may also be as investigate CNN classification using additional image channels other than RGB. Increase the dataset size and using data augmentation can also be expected to improve the detection performance.

In India, there's a drastic change in Agri-Tech. Not most of the farmers are using latest tech gadgets in their farms. we regularly see IoT related agriculture in several journals but none of them are properly adopted in Indian farms. there's a large gap between technology and farmers in India. Many start-ups have emerged to bridge this gap between the technology and therefore the farmers. Now, even many MNCs are investing in Agri-Tech in India. Food demand is exponentially increasing thanks to rise in population. People talking about tractors and heavy machinery in farms era is now replaced by smart technology like Internet of Things, AI and Machine Learning. Smart sensors are replaced by heavy machinery in American farms. Farmers are using technology like temperature and moisture sensors, drones, smart irrigation, terrain contour mapping, self-driving and GPS enabled tractors/rovers - to provide food more sustainably. in line with "The Economist", farmers are being "teched up" when it involves growing

crops/food more sustainable and profitable. it's often heard that pests and diseases attack crops and thus food gradually reduces thanks to these attacks. By 2050, earth's population is anticipated to grow 9.7 billion. Therefore, a transparent graph of rise in food demand is visible.

Automation technology is the most focused technology by the Indian start-ups. Automated Drones and Bots are deployed in farms for monitoring and serving the crop. Day by day the technology used is also swapping from normal spraying to specified target spraying of pesticides and fertilizers in the farms. Artificial Intelligence, Machine Learning and Deep Learning algorithms are adopted to monitor the crops precisely and detect the faulty areas in the farms, hence spray corrective solution in that specific target area.

III. POTATO DISEASE AND SYMPTOMS

1. Bacterial Wilt

Disease symptoms: In addition to the potato, the pathogen also damages plants such as chili, tomato, tobacco and eggplant, as well as several species of weeds [7][8].

- The symptoms of bacterial wilt infection will be seen on all parts of infected plants.
- Infected plant begins to wilt, ranging from the guidelines of the leaves or where the stems diversify, then spreading to any or all parts of the plant.
- Leaves become yellow at their bases, then the entire plant wilts and dies. When stems are cut a brown coloured ring is going to be visible.
- When a tuber is cut in half, black or brown rings will, however, be visible. If left for a long time or squeezed, these rings will exude a thick white fluid.
- A further symptom is fluid beginning of tuber eyes. this may be signified by soil sticking to tuber eyes when crops are harvested. Serious infection causes tubers to rot



Plant showing wilting symptoms



Tuber showing wilting symptoms

2. Septoria Leaf Spot

Disease symptoms: Less vigorous plants are usually affected

- Slight, circular to irregular spots with a grey Centre and shady margin on leaves.
- Spots typically start on lower leaves and slowly advance upwards
- At later phase spots merge and leaves are blighted
- Whole defoliation of affected leaves may take place.
- Stems and flowers are sometimes attacked
- Fruits are rarely attacked

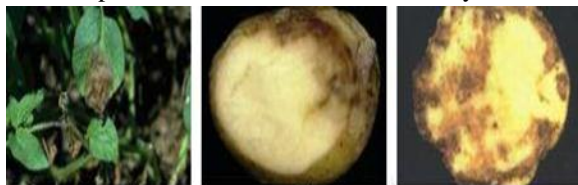


Leaves showing disease symptoms

3. Late blight

Disease symptoms: This disease damages leaves, stems and tubers. Affected leaves look blistered as if burnt by predicament and ultimately rot and dry out.

- When drying out, leaves turn brown or black in color.
- When infections are still active, spots seem on the underneath of leaves blanketed in what seems like flour.
- Affected stems start to blacken from their tips, and at last dry out.
- Simple infections cause all foliage to rot, dry out and fall to the bottom, stems to dry out and plants to die.
- Affected tubers show dry brown-colored spots on their skins and flesh. This disease turns very quickly. If it's not controlled, infected plants will die within two three days.



Leaves showing disease symptoms

Tubers showing disease symptoms

4. Early Blight

Disease symptoms: This could be a standard disease of potato happening on the foliage at any stage of the growing and causes characteristic leaf spots and blight.

- Generally, the disease signs become apparent during tuber bulking stage and develop leading to the harvest.
- the first blight is first detected on the plants as small, black lesions totally on the older foliage.
- Spots extend, and by the time they're one-fourth inch in diameter or larger, concentric rings in a very bull's eye shape are often seen within the Centre of the diseased area.
- Tissue surrounding the spots may turn yellow. If warmth and humidity occur at this

time, much of the foliage is killed. Lesions on the stems are almost like those on leaves, sometimes girdling the plant if they occur near the soil line.



Leaves showing disease symptoms

Tuber showing disease symptoms

5. Common scab

Disease symptoms: Pathogen infects new evolving tubers over the lenticels and infrequently through wounds.

- Indicators of common potato scab are quite variable and are showed on the surface of the potato tuber.
- The disease forms several forms of cork-like lesions including surface.
- Damaged tubers have rough, cracked skin, with scab-like spots.
- Severe infections leave potato skins covered with rough black welts.
- Early infections effect in superficial reddish-brown spots on the surface of tubers. because the tubers grow, lesions expand, becoming corky and necrotic.



Tubers showing disease symptoms

6. Black Scurf/ Canker

Disease symptoms: Rhizoctonia canker occurs when stolon's contact soil borne fungal bodies.

- Pathogen blights plant tissue and causes stolon blinding thus reducing tuber production and yield.
- It also infects tubers causing black scurf but this is purely cosmetic, reduces tuber appearance and does not reduce yield.



Tubers showing disease symptoms

7. Viral Disease

Disease symptoms: Potato virus Y (PVY) may be a Potyvirus, causes stipple streak. The necrotic strain usually causes slight foliage symptoms, but necrosis within the leaves of susceptible potato varieties.

Potato virus S (PVS) may be a Carla virus, if plant infected early within the season, show a small deepening of the veins, rough leaves, more open growth, mild mottling, bronzing, or tiny necrotic spots on the leaves. PVS is transmitted by aphids non-persistently. • Potato virus X (PVX) is that the type member of the Potyvirus family of plant viruses. Plants often don't exhibit symptoms, but the virus can cause symptoms of chlorosis, mosaic, decreased leaf size, and necrotic lesions in tubers. • PVX can interact with PVY and PVS to cause more severe symptoms and yield loss than either virus alone. The source of this virus is infected tubers.



Tuber showing disease symptoms due to Potato virus Y

Leaves showing disease symptoms due to Potato virus Y



Leaves showing disease symptoms due to Potato virus X

8. Potato Spindle Tuber Viroid (PSTVd)

Disease symptoms: It causes mild foliar symptoms including smaller leaves that curl downward, giving the plant a more upright growth habit. Plants may also be stunted, and leaves will be grey and distorted. • The stems are often more branched, with the branches having sharp angles on the stem. • Tubers become narrow and spindle or oblong in shape, or more rounded than expected for a selected variety, and have prominent eyebrows. • Tubers may also become cracked or develop knobs and swellings.



Leaves and tubers showing disease symptoms

9. Black leg and soft rot

Disease symptoms: Black leg may be a rot of the lower stem area. this is often encouraged by cool, damp situations. • Soft rot occurs when the bacteria gains access to the tuber through wounds & other entry points. • Symptom can range from cultivator damage to fungal lesions. • The bacteria dissolve the cell walls and liquefy the tuber inwards. No distinct smell is present in true plant disease [17].



Seedlings and tubers showing disease symptoms

IV. DIFFERENT TECHNIQUE

Image Processing: Digital image processing has three elementary steps: image processing, analysis and understanding. Image processing holds the preprocessing of the plant leaf as segmentation, color extraction, diseases specific data extraction and filtration of images. Image analysis usually deals with the classification of diseases. Plant leaf are often classified supported their morphological features with the assistance of varied classification techniques. These classifications are often defined various properties of the plant leaf like color, intensity, dimensions [9].

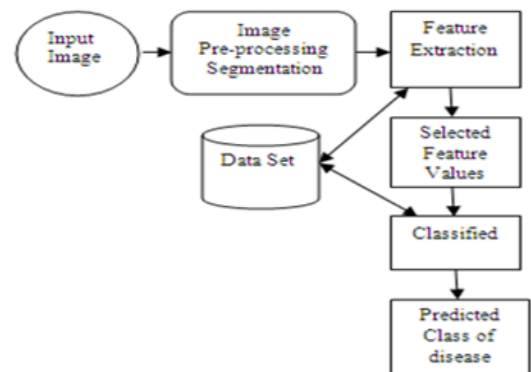


Fig 1: Basic Steps in Image processing to detect plant diseases

Machine learning methods: A support vector machine comes under supervised learning model within the machine learning. SVM's are mainly used for

classification and multivariate analysis. SVM must be connected with learning algorithm to supply an output. SVM has given better performance for classifications and regressions as compare to other processes. There are sets of coaching which belong to 2 different categories [10][11]. machine learning methods focus on data themselves and emphasize the performance of certain tasks. Machine learning can be applied to four areas based on the problems to be solved: 1) identification/detection 2) classification; 3) quantification; 4) prediction. On the other hand, based on whether outcomes are labeled, machine learning is divided into two categories: 1) supervised learning and 2) unsupervised learning [12].

The SVM training algorithm creates a model that allots new examples into one category or into the opposite category, which makes it non-probabilistic binary linear classifier. The illustration in SVM shows points in space and also, they're mapped that the examples bump into as they need been divide by a spot which is as wide as possible. Support vector machine (SVM) have used for classification in diseased detection process in leaves. machine learning techniques like SVM,[13] Gaussian Naïve bayes, logistic regression, linear discriminant analysis, Random forests gave more accuracy with a smaller number of image data set. First convert RGB image into gray scale image. Machine learning techniques are accustomed train the model which helps to require a correct decision regarding the diseases. Once the datasets are trained, supported the accuracy of various techniques, select the simplest model for testing. [14]

K-means: The k-means algorithm tries to separate the information set which contains the knowledge of particular data set into a hard and fast number of clusters (k). Primarily k numbers of centroids are chosen. A centroid may be a information which is situated at the middle of a cluster. The centroids are picked every which way from this input file set such all centroids are unique and vary from one another. These centroids are used train the SVM. Then it produces randomized set of the clusters. The algorithm consists of the subsequent steps: 1) The K points are placed into the space which is represented by the objects that are clustered. They represent initial clusters of centroids. 2) Each object is assigned to the group that has closest centroid. 3) After assigning all the objects recalculate positions of the K

centroids. 4) Repeat the step 2 and three till the centroids are at one place and don't move longer. This ends up in the separation of the objects into the groups. Thereafter each centroid is ready to the first moment of the cluster which it's defined to. The set of ultimate centroids are going to be wont to produce the classification/clustering of the information which is given because the input [15]. The K-Means clustering algorithm tries to classify objects based on a set of features into K number of classes [16]. The segmentation based on K-means technique is a partition clustering technique used to partition n number of observations into k clusters. In this technique, k is the number of clusters in the segmented image and colors present in an image are used for the clustering. The main advantage of segmentation-based K-means clustering technique is that it works on local information and global information of image. K-means clustering algorithm is easy to implement and fast, robust and flexible [17].

The k-nearest neighbors (KNN): it's an easy, easy-to-implement supervised machine learning algorithm that may be wont to solve both classification and regression problems [18]. The KNN is that the classification technique which is applied to classify similar and dissimilar data into over one classes. The training samples are depicted by n dimensional numeric attributes. Every sample represents some extent in a dimensional space. Along these lines, the greater a part of the training samples is stored in an n-dimensional pattern space. At the purpose when given an unknown sample, a k-nearest neighbor classifier looks the pattern space for the k training samples that are closest to the unknown sample. "Closeness" is defined in terms of Euclidean distance. Not in the least like decision have tree induction and back propagation, nearest neighbor classifiers assigned hit with weight to each attribute. this might cause confusion when there are numerous irrelevant attributes within the data. Nearest neighbor classifiers can likewise be utilized for prediction, that is, to offer back a real valued prediction for a given unknown sample. For this example, the classifier gives back the typical value of the real valued related to the k nearest neighbors of the unknown sample. The k-nearest neighbors' algorithm is among the best of all machine learning algorithms. This is often the ultimate step within the image processing. During

this step the image is assessed into a particular class by making use of the features that were inherited within the feature extraction step. During this work we use classification to classify the diseases that the leaves are having. At this step our machine learns the way to provide a noun to a diseased leaf. There are many algorithms that may be used for classification. During this work, we are using KNN (k-Nearest Neighbor) algorithm [19].

Back propagation: To train the substitute neural network back propagation is that the one amongst the tactic which is combined with gradient descent optimization technique. This method analyzes the gradient of a loss function with respects to any or all the weights within the network. in an exceedingly recurrent network Back propagation algorithm artificial neural network is employed. Once it trained, the neural network weights are fixed and it are often accustomed calculate output values for brand spanking new test images which don't seem to be present within the learning dataset.[20]

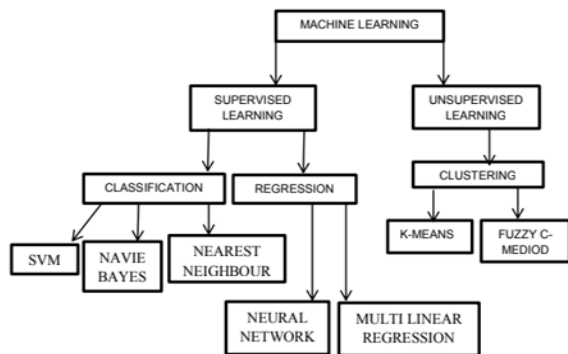


Fig:2 Block diagram of machine learning methods

Table 1. Classification techniques Comparison

Technique	Advantages	Disadvantages
K-Nearest Neighbor (KNN)	Simpler classifier as exclusion of any training process. Applicable in case of a small not trained dataset.	More training samples- more speed of computing distances sensitive to irrelevant inputs so expensive testing every time.
Radial Basis Function (RBF)	Faster Training. Hidden layer is easier to interpret.	It is slower in execution speed
Probabilistic Neural Networks (PNN)	Tolerant to noisy inputs. Instances classified to many outputs adaptive to change data.	Long training time. Complex network structure. Excessive memory for

		training data.
Back propagation Network (BPN)	Easy to implement. Applicable to wide range of problems. Able to form arbitrarily complex nonlinear mappings	Learning can be slow. It is hard to know how many neurons as well as layers are required.
Support Vector Machine (SVM)	Simple geometric interpretation and a sparse solution. robust, when sample has some bias.	Slow training. Difficult to understand. For classification large support vector required

V. CONCLUSION

This paper reviews and summaries some basic disease in potato and techniques utilized in disease detection using leaf images. a comparative study is meted out on five forms of machine learning classification techniques for recognition of disease is completed during this review. SVM classifier is employed by many authors for classification of diseases when put next with other classifiers. in future run through the employment of those technique we are able to work on early detection of anyone of those potato diseases.

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