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# Comprehensive Survey on various Plant Disease Detection Techniques based on Machine Learning

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***Abstract:*** ***From ancient times, most of the population of India has been dependent on the agriculture and this is the reason why a delay in plant disease detection is being a cause of decline in the economic growth. This is because there has been a practice of consulting experts for observing plants with their naked eyes to detect the type of disease the plants are suffering from. For this purpose, teams with large number of experts are made and they continuously monitor the plant. This procedure is quite expensive when the farms are very large. Sometimes, the farmers do not have the developed and advanced technology, which leads to the delay of disease detection. In such cases contacting the experts is not an easy task, it is expensive as well as time consuming. On the other hand, if advanced technologies are used, the task of detection will become less expensive and less time consuming. The plant diseases can be detected with the help of image processing techniques which processes the image for any digital information present in the image. These techniques are gaining more attention as the technological advancement is occurring in the field of computer science. Here, in this paper we will discuss some image processing techniques used for this purpose.***

***Keywords: Digital image processing, plant disease detection, machine learning***

## I. INTRODUCTION

India is a farming nation. About 70% of Indian population depends on the farming sector for their livelihood. Agriculture is a major occupation in India. The whole family of farmers depends on their farms and yield for their financial needs. However, different types of plant infections affect the plants and the crops.

This results in the lowered quality and quantity of the farming goods. The patterns which can be monitored by naked eyes are described by the study of plant infections. This study provides support in the monitoring of plant health and plant infections. In ancient times, the proficient people used to monitor agricultural farms in manual manner. This process was very time consuming and needs a lot of expertise. In order to identify infections within plants leaves, a technology named image processing technique has been used.

The signs of infections occur on the plant leaves, stem and fruit. Too much use of fertilizers and pesticides is ruining plant and the crops. Agriculture is the backbone of Indian economy. Therefore, it is not possible to neglect farming sector to achieve sustainable economic growth.

The specialists perform visual monitoring of plant disease. In this way, they detect and recognize the different sorts of plant infections. For performing this observation, teams with large number of experts are made and they continuously monitor the plant. This procedure is quite expensive when the farms are very large. Sometimes, the farmers do not have the developed and advanced technology, which leads to the delay of disease detection. In such cases contacting the experts is not an easy task, it is expensive as well as time consuming [1]. On the other hand, if advanced technologies are used, the task of detection will become less expensive and less time consuming. Generally, there are some common diseases plants are suffering that is brown and yellow spots, early or late scorch and many other fungus infections. Image processing is the mechanism used to calculate and evaluate the amount of infectious part and determines the change in shade of that affected part.

## II. LITERATURE REVIEW

Abirami Devaraj, et.al (2019) [2] reviewed various plant diseases in this work. A tool named MATLAB was used to detect leaf infections by employing image processing technology. Image loading was the first step in this technology. There were some other steps involved in image processing. It was required to develop a computerized detection system using superior technique. One of these technologies was known as image processing. This technology helped farmers in disease detection at an early or preliminary phase. This technology also provided useful data to handle leaf diseases. In future, this research study would be continued for detecting several other sorts of infections.

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Santhosh Kumar S, et.al (2019) [3] explained the significance of illness recognition for both plants and human beings. It was imperative to deliberate proper input to demonstrate the effects of plant infections & techniques in agricultural sector. It was necessary to design an efficient technique for detecting and recognizing different plant diseases to help cultivators and pathologist in disease analysis. This study described the impact of image processing in farming sector. Several types of diseases were taken into account in this study for more research.

Sharath D M, Akhilesh, et.al (2019) [4] stated that plant infections had become a serious issue in farming. These diseases caused losses in the production. These diseases affected the quality of farming goods as well. It was extremely hard to monitor plant health and identify plant infections physically. A lot of expertise was required in this work. It process was also very time consuming. Therefore, for detecting plant diseases, image processing technology was used. There were various steps involved in this technique. The disease affecting the plant was monitored on the basis of outcome achieved from image processing steps. In this work, a discussion was made on the techniques that used plant images for plant infection detection.

Sukhvir Kaur, et.al (2018) [5] proposed a semi-automatic system based on rule for plant disease detection. This system used the ideas of k-means clustering algorithm. The proposed system was implemented for differentiating normal leaves from infectious leaves. Also, the classification of an infectious leaf was performed into one of the three classes. Color features, texture features, and their mixtures were used individually to carry out tests. The training of the three models was performed on the basis of these test results. The used models were based on support vector machine classifier. PlantVillage dataset was used to provide several hundred images of plant leaves. On the basis of these images, results were achieved. For all the used mixtures, satisfactory average accuracy rates were obtained. The achieved results were superior as compared to existing results. Discovering the optimum feature set to detect Soybean leaf infection was the main aim of this work. The proposed system was also proved extremely efficient in the measurement of infection harshness.

M S., et.al (2018) [6] stated that specialists detected and classified plant infections by monitoring them. The decision whether the plant is infected or not is completely depends on the physical conditions of the observer like fatigue, eye sight, work pressure and climatic conditions. Hence, this method requires less time and less efficient. Another method is used to detect diseases is image processing which requires small time and more efficient. MATLAB toolbox is used to calculate the damage caused to plant due to the diseases. In this paper, the symptoms of the diseases are also described. The proposed system is also used to classify and differentiate between the healthy and unhealthy plants. The proposed system reduces the monitoring task of the farmers. The farmers can now easily predict and diagnose the diseases at the very initial stage. The results show that the recommended system is competent in discovery and identification of the leaf diseases. Also, the infections could be predicted timely and improved the recognition using different classifiers.

Abed et.al (2018) [7] focused on the detection of two types of diseases of the bean leaf. Various steps were included in the procedure of disease detection. Firstly, the pictures were captured for the openly available database. This approach is efficient enough to detect the diseases at their early stages with an accuracy of 100 %. This proposed system selects the clusters automatically thus improving its performance. In this system, the users have to select the value of infected cluster of the leaves and plant manually because the clustering value changes when the testing images are entered in the system. Thereafter, the proposed system shows effective and accurate results by detecting and classifying the diseases present in the leaf.

Hossain et.al (2018) [8] proposed SVM as an approach for the detection of diseases in plants and crops. The author studied eleven characteristics acquired from this technique. These features are capable of finding the appropriate match of the disease whenever an image is uploaded into the system. In this research the number of features are reduced after the comparison being performed by the SVM classification model. In this model, every leaf requires 300ms less processing time when compared to the earlier SVM technique and also attained a high accuracy. The proposed system is capable of detecting, determining, identifying and classification with an increased efficiency of 93% as compared to the other classifiers. This technique also reduced the number of extracted features which in turn reduced the processing time.

Khan et.al (2018) [9] proposed a machine vision model for the determination of visual demonstration of leaf infection. For this purpose, the researcher analyzed the pictures in CIELab color space. The main aim of this work was to develop an approach for the detection of different types of plant infections automatically. For this purpose, a cascaded unsupervised image segmentation algorithm was used. This work uses a multilevel segmentation algorithm and expectation maximization algorithm was used along with the limitation of minimal ocular information loss to perform preliminary segmentation. The tested results proved that the proposed work is capable of retrieving the contaminated areas better and thus provides accurate results.

Mattihalli et.al (2018) [10] presented a methodology to detect leaf infections in early stage. This approach worked on the extracted features of the images. The approach contained a tool known as Beagle Bone black. This device was linked with digital camera and

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identified infections within leaves. The pictures of the leaves were clicked and then a comparison of infected leaves and normal leaves was performed. These pictures of healthy leaves were stored in the database. Once the image processing was done, the plants with some diseases are turn on the valves by which drug was mechanically supplied to the infected leaves. The researcher concluded that the proposed system was effectual, less expensive and accessible.

Jaskaran Singh et.al (2018) [11] reviewed various methodologies to identify leaf infection in terms of different parameters. Diseases are identified by using various image processing methods. It refers as the methodology which processes the digital information saved in the picture format. On the other hand, plant diseases recognition is the mechanism having three stages: first, the images are fed into the terminal for pre-processing, and then the images are analyzed according to the segmentation features and at last the classification of the picture is performed by employing some desired classification model.

Agrawal et.al (2017) [12] presented the improvements done on the already proposed classifiers employed in plant infection recognition. Till now the detection techniques used are based on the extraction of statistical features. In this process, RGB signals are converted into LAB form. The results of already presented techniques do not change even after the variation in backdrop glow. Therefore, the purposed researches of HIS images are inserted to the database and the SVM technique is used. The diseases should be identified at its initial stage, in order to protect the productivity of the crops and to save cultivators from losses. Hence, the researcher proposed various methods and techniques for the identification of plant diseases especially at their initial stages. Farmers are now provided with all essential needs and advance technologies to make their work easy and time saving. In this paper, the researcher describes the diseases in grapes and builds a model for infection discovery in grapes. The researcher had proposed a method for the classification and detection of plant infections which he called image processing In this, farmers can capture images of affected part of the plants and after that the image is transported to the experts. In this paper, the researcher proposed an automatic detection of grape leaf disease; it works on the accordance of k-means clustering method and SVM classifier.

Bharate et.al (2017) [13] reviewed image processing methods to detect plant infections. This paper includes research on different plants. Frequent and popular classification models to detect diseases are known as artificial neural network (ANN) and support vector machine (SVM) classifier. The automatic disease detection solves the issue of costly domain. The researcher concluded that an early detection of infections helps the farmers to improve their yield. The major aim of this study was to monitor the diseases on plants and suggest best and better solutions for them which help in increasing production. There are various available approaches that use two image databases. One database is used for query of pictures and another one is used to train pictures. Some fruit like apple, grapes, pomegranate, if suffering from any kind diseases can be detected by any of the proposed methods. The growth and productivity of the fruits is decreasing day by day due to the excessive use of chemicals. Several methods were described by the researcher to avoid such issues.

Dhaware et.al (2017) [14] implemented a novel technique based on image processing to classify unhealthy plant leaves in automated manner. In order to implement proposed system, the real time applications could be used. The pictures were captured straight away from the agriculture field devoid of hard work using this technique. The proposed system could provide suggestions to the farmers with minimal hard work. Mobile camera was used by the farmer to capture image of the plant leaf. The captured image was forward to the DSS system without adding more inputs.

Gaikwad et.al (2017) [15] develops software which automatically detects and classifies theplant diseases. It takes place in four steps. In this process, the shade, form and dimension of the images is considered. Automatic neural network is implemented to detect the plant infections. The proposed algorithm detects and classifies the fungal diseases in the wheat plant. The researcher concluded that this technique may be implemented to identify and classify the infections in many other plants. It is extremely crucial to detect plant infections to have a good quality of fruits and crops. The diseases should be detected at their initial stage, so that there will not be any further loss. Many farmers detect the plant diseases by observing them by naked eyes, which requires incessant supervision and knowledge. This process needs a lot of time and costly too. An automated approach is required to detect plant leaf infections.

Gupta et.al (2017) [16] proposed an algorithm to detect powdery mildew diseases using plant pictures. This methodology employed an automatic strategy to remove backdrop images and then infected portion was extracted from that image. The mixture of the morphological operations and threshold values based on intensity were utilized to make method more efficient and less complicated. The researcher concluded after the outcomes that proposed approach achieved 99% accuracy and the morphological operations with intensity also provided much better results. Some other techniques to extract Powdery Mildew infection with more enhanced computational rate could be developed in nearby future.

Hase et.al (2017) [17] suggested the use of an android application for identifying the reason and solution of plant infections. The proposed approach worked on different types of infected plants. Image processing approach was used for detecting and classifying different types of infections such as fungus, bacteria etc. This android app proved extremely helpful for cultivators. Using this

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application, farmers could detect infections in an easy way. This application helped farmers to understand avoidance procedures and ideas. This investigative study was based on texture analysis. The infections within plants were detected more accurately using texture analysis. Grabcut algorithm was used to successfully extract foreground from plant pictures. An approach named Fast library for approximate nearest neighborhood (FLANN) was implemented for efficient feature matching. The focus would be on the designing of novel application with all regional languages in nearby future. Nowadays, all farmers have smart phones with Android OS. Therefore, it would be advantageous to use multilingual application in this situation. The second aim of this system is Federated cloud storage. This scheme will provide speedy and efficient solution for the doubt.

Indumathi et.al (2017) [18] suggested a new diseases recognition system to detect and classify the infected plants. The researcher also proposed for the segmentation which is very not as complicated as k-means clustering methods. The features collected from the images being segmented is transferred to the monitoring site through the sensor nodes. In these monitoring sites the images are analyzed and classified sing Support Vector Machine classifier. The functioning of the suggested approach is measured by checking the accuracy and a comparison is also made with the existing k-means clustering classifier. Various experiments were conducted and it was concluded that the suggested approach shows the accuracy rate of 98%. The simulations are performed on the MATLAB and show the outcomes that the proposed system enhances the accuracy and performs much better than the k-means clustering technique.

Islam et.al (2017) [19] suggested a novel technique in which the diseases are diagnosed using image processing and machine learning. This classifier classifies the infections on potato from the publically available plant images known as Plant Village. The proposed classifier demonstrates the diseases classification is performed on more than 300 pictures and shows an accuracy rate of 95%. This research concludes that the proposed system offers farmers more feasible, efficient and time saving technique to identify leaf infections. Potato is the most important crop being used in almost everywhere. But it is also suffering from some kind disease which directly affecting its yield and growth. There are two diseases like Phytophthora infestans and Alternaria solani, which affecting the growth of the potato. Early detection and identification of such disease can help to stop them and avoids the degradation of the potato.

Kaur et.al (2017) [20] presented a wide-ranging study on fruits infections. It was analyzed that that automatic disease recognition technique consumed less time than manual method. The image was degraded due to noise. Therefore, this work also explained various denoising techniques. This work arranged fruit infections in a table format. This study represented a common fruit infection called blight. This disease infected various fruit plants. The picture of diseased leaf was used to deal with this infection. This picture was embedded into the system for inspection. Different types of image processing methods could be implemented for detecting infections in early phase. The future work would focus on SVD scheme to deal with fruit infections in cost effective manner.

Masazhar et.al (2017) [21] presented that the image processing method is used to detect leaf infections. This technique was also used to classify the infected plants and the plants having oil palm plant infections. The researcher utilized k-means clustering approach for the detection of the diseases. Multiclass SVM classifier was used to recognize plant infections on the basis of the symptoms of the diseases shown by the infected plants. K-means clustering was used to classify thirteen sorts of attributes retrieved from the pictures of the leaf. Also, the classification was performed with the SVM approach. The researcher concludes that the suggested system was much more reliable to detect and classify the infections by ensuring the symptoms of the diseases and also isolated the infected leaf prior to transfer it for disease treatment.

Bharat Mishra et.al (2017) [22] presents a survey of different technologies utilized to classify and identify the leaf infections on the basis of the usage of image processing. All the prevailed methodologies were employed to detect leaf diseases and which very critical. The existed approaches and the proposed approaches were compared and examined. In this paper, the important and challenging issues were discussed. The researchers concluded that the proposed approaches are less complex and consumes very less time to detect and classify leaf infections. It is possible to discover pant diseases by analyzing the variation in their signs, spots, and color and so on. The farmer should use such methods which are less time consuming, easy to use and easily affordable to all the farmers. In Image processing, the image is clicked using digital camera of the affected part of the plant. The diseases should be detected at their early stages in order to reduce the further loss.

R. P. Narmadha et.al (2017) [23] stated that various disease prevents and stops the growth of the paddy plants. These diseases infect the plant at different growing stages and to all the other parts from leaf neck to the node. The paddy diseases are caused due to bacterial infection, fungus and so on. The approach was introduced to remove the noises automatically and minimizes the time taken to measure the infected plant diseases. In this paper, the author calculates the digital image processing for the detection, diagnosis, reorganization of the crop leaf infections based on the usage of the k-means clustering technique and it also increases the accuracy.

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There are various techniques used to identify diseases in paddy plant. Recently, the researcher had recommended an approach called image processing to detect plant diseases in early phase.

## III. CONCLUSIONS

For the purpose of detecting plant diseases, different image processing techniques are being implemented. But the resultant image is influenced by the background data. The optimization technique is utilized to detect infections of some specific plant in the real-world field conditions. The automation technique can be utilized to look out the plant continuously in automatic manner. The different studies recommend that the good potential is shown by the disease detection techniques in the detection of plant diseases. However, these techniques have some limitations. Thus, a lot of research work need to be carried out in the area of plant disease detection.

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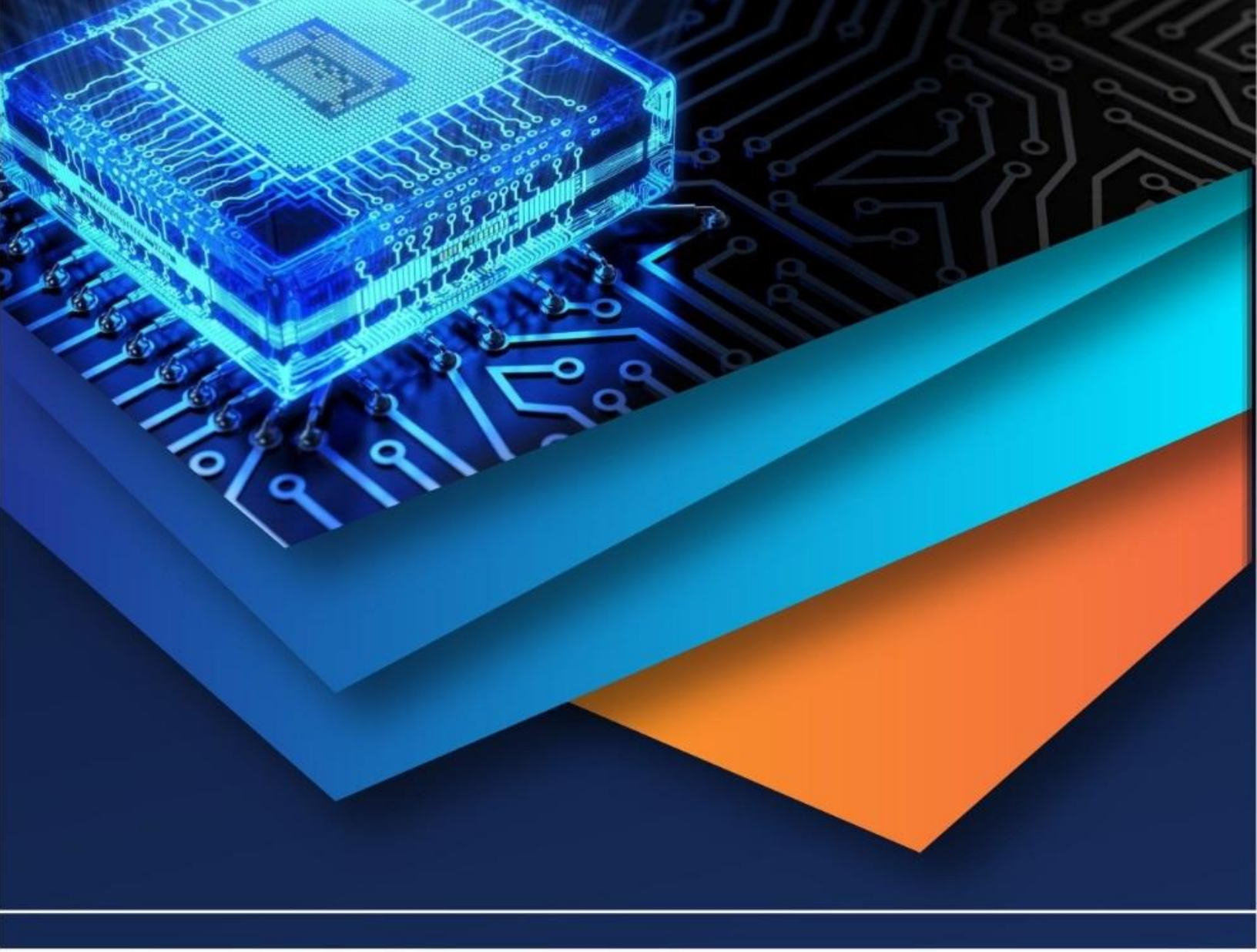

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