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A Review on Plant Disease Detection Techniques

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Abstract-Agricultural production is one of the most important sources of revenue for the economy. Agriculture is regarded as one of the most important pillars of the Indian economy. Agriculture contributes significantly to the country's GDP and gives employment to a huge number of individuals in the farming industry. Plant disease disrupts normal plant growth and is one of the leading causes of lower production, which leads to economic losses. Early detection of disease aids in the development of treatments that can slow the spread of disease in plants. One of the reasons why plant leaf disease detection is so crucial in agriculture is because of this. Leaf inspection is regarded as one of the most effective methods for diagnosing plant diseases. Computer vision and machine learning techniques are extremely beneficial for identifying and comprehending data from digital photographs. The main focus of the research is on different algorithms for detecting plant illness. This research will assist researchers and students in selecting the optimum algorithm based on previous research.

Keywords- Plant leaf disease, classification, image processing.

I. INTRODUCTION

Agricultural products are utilized to meet the needs of both animals and humans on a regular basis. Agriculture has influenced everyone's life in some way, whether directly or indirectly. It is the method of crop production that results in the provision of food, which is the foundation of everyone's existence. Whether a person lives in a metropolis or a village, they all rely on crop production to survive. Agricultural production is one of the important sources of economic development of India. About 70% of Indian economy relies on agriculture. Hence, damage to the crops would cause huge loss in agriculture production and would ultimately affect the economy.

Agriculture is one of India's most important sources of economic development. Agriculture accounts for over 70% of the Indian economy. As a result, crop damage would result in a significant reduction in agricultural production, which would have a negative impact on the economy. Initially, the method for inspecting plants for illnesses was simple naked eye inspection, which is a time-consuming procedure that necessitates experts manually inspecting crop fields. A variety of strategies have been used in recent years to produce automatic and semiautomatic plant disease detection systems. These methods are far faster, less expensive, and more accurate than farmers' traditional approach of manual observation. As a result, researchers are being encouraged to develop more sophisticated technological methods for disease diagnosis that do not require human participation.

Plant leaves are a sensitive portion of the plant that shows disease symptoms first. From the beginning of their life cycle until they are ready to be harvested, the crops must be monitored for plant leaf diseases.

II. LITERATURE SURVEY

Image processing is a technique for evaluating, processing, and locating features. It takes care of image acquisition, preprocessing, and segmentation, as well as extraction. Machine learning may be used to evaluate a picture and extract information that aids in the analysis of the image. This section describes research in several disciplines such as fruit grading systems, weed identification, plant classification, and so on.

1. Machine Learning Classification Techniques for Plant Disease Detection was evaluated by Mrs. Shruthi U, Dr. Nagaveni V, and Dr. Raghavendra B K. This paper conducted a comparative analysis of five different machine learning classification techniques for recognising plant diseases. The accuracy of the procedures was demonstrated in the following way in the study: The SVM classifier has an accuracy range of 89 to 97%, while the ANN classifier has an accuracy range of 90 to 93%, the KNN classifier has an accuracy range of 95%, the Fuzzy Classifier has an accuracy range of 88%, and the CNN classifier has an accuracy range of nearly 99 % [1].

2. A Multiclass Plant Leaf Disease Detection Using Image Processing and Machine Learning Techniques was proposed by Nilay Ganatra and Atul Patel. Using digital image processing and machine learning approaches, they proposed an automated prediction model for leaf disease identification and categorization. They used various pre-processing and segmentation approaches to effectively extract various types of characteristics. The

proposed prediction model outperforms existing classifiers with a random forest accuracy of 73.38%, whereas SVM, ANN and KNN accuracy are 67.27%, 65.68%, and 63.20%, respectively [2].

3. A method for developing a system for automatically detecting plant diseases was developed by Debasish Das, Mahinderpal Singh, Sarthak Swaroop Mohanty, and S. Chakravarty. The focus of this paper was on a system for automatically detecting tomato leaf disease. The major goal was to locate the infected or affected portion of the tomato leaf. The tests were carried out using three methodologies, with the SVM achieving an accuracy of 87.6%, while Logistic Regression and Random Forest achieved 67.3% and 70.05%, respectively [3].

4. Machine Learning for Plant Disease Detection: The goal is to determine whether the leaf is healthy or sick. Machine learning, image processing, and a Histogram of Oriented Gradients feature are all included in the technology.

It demonstrated that the random forest algorithm is more efficient than others. The image of a leaf is preprocessed using the HOG feature to compare it to the dataset using the Random Forest machine learning technique. It has the benefit of detecting abnormalities in plant leaves with a 70% accuracy rate. The constraint is that RGB must be transformed to grayscale before Hu moments and Haralick features can be computed, and it only detected diseased leaves [4].

5. Image Processing Techniques for Disease Detection in Plant Leaves: The goal is to find the plant's illness. Image Enhancement, Clustering, Features Extraction, and Image Acquisition are some of the technologies used. The main image processing utilised for the diagnosis of leaf diseases is k-means clustering, which is summarized in this article. This procedure can help to ensure a precise diagnosis of leaf disease. The biggest benefit is that it is 88% accurate. And there's a catch: it's only good for leaves, not other sections of the plant [5].

III. PROPOSED WORK MODEL

This section explains the general process of plant disease identification. The block diagram of the method is shown in fig.1. Discussion of processing steps is done below: [1] Dataset The dataset collects photos of diseased and healthy leaves. These photos will be used in the next stage, which is pre-processing.

Fig. 1. Block Diagram of Methodology.

[2] Image Pre-Processing Image processing is the process of converting an input image to a digital frame and then performing a series of operations on it to create a new image or separate some important data. Image Enhancement, Color conversion, Filtration and Segmentation are all part of the image pre-processing.
[3] Feature Extraction The feature extraction technique is crucial. The main parameters in image classification are features, shape feature extraction, color feature extraction, and other features were surveyed.
[4] Splitting Dataset The dataset is divided into two parts: training and testing sets. This is done to prevent over fitting and under fitting of data.
[5] Classification Algorithms The next stage is to construct a Machine Learningbased classification model. Algorithm techniques such as CNN, K-means, SVM, KNN, ANN, Random Forest, and Logistic Regression are used to build a classification model. These algorithms use the training dataset. [6] Output The predicted disease along with its curing measures and suitable pesticides is given to the user.

V. TECHNIQUES

[1] Convolutional Neural Network Convolutional neural networks, often known as covnets, are neural networks with shared parameters. Assume you have a picture. It can be visualised as a cuboid with length, breadth (image dimension), and height (as image generally have red, green, and blue channels). Convolution layers are made up of a series of filters that can be learned (patch in the above image). Each filter has a narrow width and height, as well as the same depth as the input volume (3 if the input layer is image input). A covnet consists of a series of layers, each of which turns one volume into another using a differentiable function. Input Layer, Convolution Layer,

Activation Function Layer, and Pool Layer are the different types of layers.

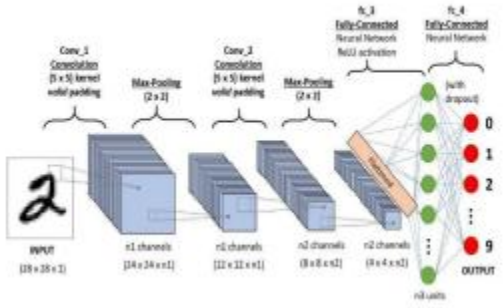

Fig. 2. Convolutional Neural Network

[2] K-Means Clustering Unsupervised Learning algorithm K-Means Clustering divides the unlabeled dataset into various clusters. K specifies the number of pre-defined clusters that must be produced during the process; for example, if K=2, two clusters will be created, and if K=3, three clusters will be created, and so on. It allows us to cluster data into different groups and provides a simple technique to determine the categories of groups in an unlabeled dataset without any training. It's a centroid-based approach, which means that each cluster has its own centroid. The main goal of this technique is to reduce the sum of distances between data points and the clusters that they belong to. The K-means Clustering Algorithm is illustrated in the diagram below.

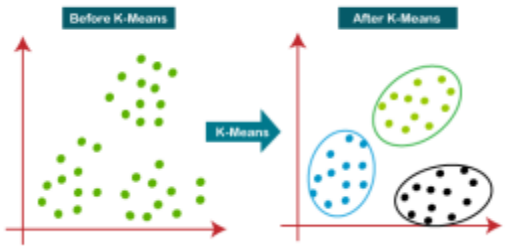

Fig. 3. K-Means Clustering Technique.

[3] Support Vector Machine (SVM): Support Vector Machine (SVM) is a supervised machine learning algorithm that is used mostly for classification problems, but also for regression challenges. In classification challenges, the data is segregated using the best decision boundary, i.e., the hyper plane. It chooses the extreme points i.e., the support vectors, that help in creating the hyper plane. We also have the positive hyper plane which passes through one (or more) of the nearest positive points and a negative hyper plane which passes through one (or more) of the nearest negative points. The optimal hyper plane is the one where the margin, distance between positive and negative hyper plane, is maximum as shown in fig.2.

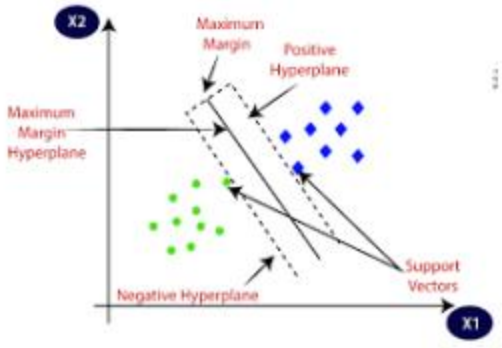

Fig. 4. Support Vector Machine(SVM) Technique

[4] K-Nearest Neighbor(KNN) The K-Nearest Neighbour algorithm is based on the Supervised Learning technique and is one of the most basic Machine Learning algorithms. The K-NN method assumes that the new case/data and existing cases are similar and places the new case in the category that is most similar to the existing categories. The K-NN method stores all available data and classifies a new data point based on its similarity to the existing data. This means that new data can be quickly sorted into a well-defined category using the K-NN method. The K-NN approach can be used for both regression and classification, but it is more commonly utilised for classification tasks. It's also known as a lazy learner algorithm since it doesn't learn from the training set right away; instead, it saves the dataset and performs an action on it when it comes time to classify it. During the training phase, the KNN algorithm simply stores the dataset, and when it receives new data, it classifies it into a category that is quite similar to the new data

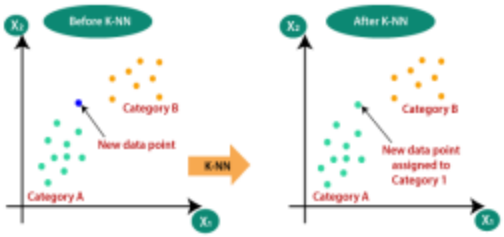

Fig. 5. K-Nearest Neighbor(KNN).

[5] Artificial Neural Network {ANN} ANN learning has been effectively used to learn realvalued, discrete-valued, and vector-valued functions containing challenges such as analysing visual scenes, speech recognition, and learning robot control techniques. The discovery that biological learning systems are made up of extraordinarily intricate webs of interconnected neurons in brains spurred the research of artificial neural networks (ANNs). ANNs, on the other hand, are less motivated by biological neural

systems since biological neural systems have many intricacies that ANNs do not model. Some of them are depicted in the diagrams.

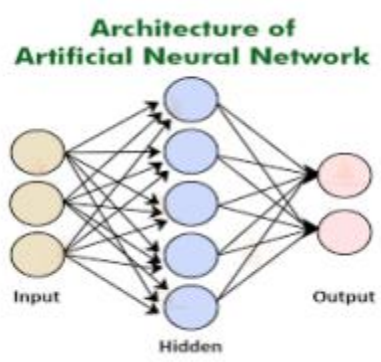

Fig. 6. Artificial Neural Network.

[6] Random Forest: Random forest is a supervised machine learning algorithm that is based on ensemble learning. In ensemble learning, multiple classifiers are combined to solve a problem to improve the performance of the model. Random forest contains several decision trees on different subsets of the same dataset and the average is taken for improved accuracy as shown in fig. 4. Multiple decision trees predict the output and the random forest takes the majority of these predictions for the final output. As the number of individual trees in the forest increase, the accuracy also increases. It is assumed that in the random forest, all the trees predict the correct output. It works in two phases. In the first phase, the random forest is created by combining different trees. In the second phase, the output is predicted for all the decision trees. Random forest is a very efficient way for solving classification and regression problems in Machine Learning.

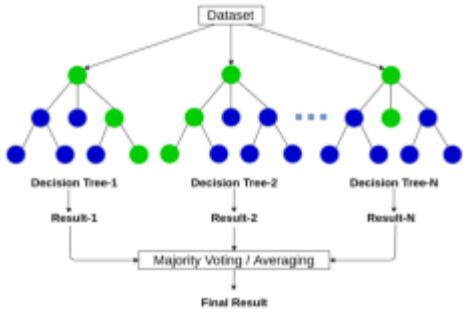

Fig. 7. Random Forest Technique.

[7] Logistic Regression Another supervised learning technique for solving classification issues is logistic regression. We have binary or discrete dependent variables in classification problems, such as 0 or 1. The categorical variables used in the logistic regression technique include 0 or 1, Yes or No, True or False, Spam or non spam, and so on. It is a predictive analytic method that is based on the probability notion. Although logistic regression is a form of regression, it differs from linear regression in terms of how it is utilized. The sigmoid function, often known as the logistic function, is a complicated cost function used in logistic regression. In logistic regression, this sigmoid function is used to model the data. It employs the idea of threshold levels, with numbers over the threshold level being rounded to 1 and below the threshold level being rounded to 0.When we give the function the input values (data), it returns the S-curve as follows.

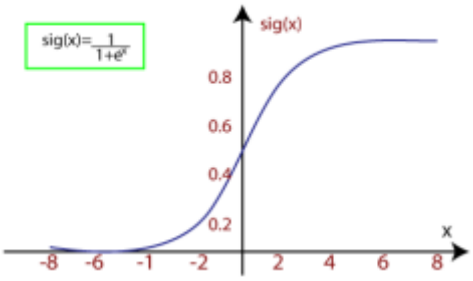

Fig. 8. Logistic Regression Technique.

Results

From this survey, performance of different algorithm is compared in table 1.

Table 1.Performance Comparison

Sr. no	Reference	Algorithms	Accuracy
1	Machine Learning Classification Techniques for Plant Disease Detection	SVM	89 to 97%
		ANN	90 to 93%
		KNN	95%
		CNN	99 %
2	A Multiclass Plant Leaf Disease Detection Using Image Processing and Machine Learning Techniques	Random Forest	73.38%
		SVM	67.27%
		ANN	65.68%
		KNN	63.20%
3	Leaf Disease Detection using Support Vector Machine	SVM	87.6%
		Logistic Regression	67.3%
		Random Forest	70.05%
4	Machine Learning for Plant Disease Detection:	Random Forest	70%
5	Image Processing Techniques for Disease Detection in Plant Leaves	k-means clustering	88%

The performance of different classifiers based on average classification accuracy is shown in the following graph fig. 9. Fig. 9. Comparison of performance of classifiers.

VI. CONCLUSION

Convolutional Neural Network (CNN), Artificial Neural Network (ANN), K-Means Clustering, KNearest Neighbor (KNN), Support Vector Machine (SVM), Random Forest, and Logistic Regression are some of the algorithm techniques discussed in this survey paper for identifying plant leaf diseases. Machine learning has been found to play a significant impact in diagnosing agricultural leaf diseases. Using various algorithm techniques and models, many steps are taken to identify diseases. This survey paper is made up of several researchers' findings. The Convolutional Neural Network (CNN) classifier is the best accurate technique for detecting plant leaf diseases, according to this study.

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