A Review On: Plant Disease and Pests Detection Using Image Processing and ANN

Sangeetha S

Abstract— **According to the UN's Food and Agriculture Organization, global agriculture suffers annual losses of 20 to 40 percent (FAO). As a result, intelligent agriculture offers farmers the best option for eliminating these deadly insect pests by incorporating artificial intelligence methodologies with current ICT. Consequently, the production of their agriculture sector can be improved. Farmers and pesticide professionals will profit from this paper's ANN based approach to classifying pesticides automatically using artificial neural networks. Due to pest species' wide range of appearances, classifying them is far more difficult than classifying general objects, hence multi-class pest detection is a critical part of pest control that includes localization. Agriculture is one of the most important sources of income for the rural population. It has long been the most common practice. In ancient India, agriculture was done manually but the emerging technologies helped the farmers in order to improve crop production, income and reduce manpower. With the beneficiary of technologies there were many new problems encountered due to climatic events and natural disasters. One of them is pests, as pests are smaller in size and almost invisible to human eyes. Pest causes a lot of harm to crops and in order to safeguard the crops farmers use a large number of pesticides which harm crops and soil both. Several techniques haves been suggested till date for this reason, like symptoms such as spots are the best way to detect an insect. The color, size, and a number of these spots will also help in identifying the pest that has killed a plant.**

Keywords— Pests Detection, AI, Artificial Neural Networks, Plant Disease Detection Using ANN

I. Introduction

Agriculture has played a critical role in human civilization's growth. The goal of agricultural research is to boost productivity while also improving the quality of the food produced. Environmental and biological elements influence both the quality and quantity of agricultural produce. Entomologically speaking, pests and plant diseases are the most important determinants. Agriculture faces numerous challenges, chief among them being diseases and insect pests. These necessitate meticulous diagnosis and prompt attention in order to avoid catastrophic losses to the crops. For pest detection and illness identification, people typically use the naked eye method of observation. This is something that must be watched closely at all times. However, in the event of a huge farm, this is not an option. Using this method also has the disadvantages of being inaccurate, costly, and time consuming. An environmentally friendly pest control approach known as integrated pest management (IPM). The steps of IPM are detection, identification, and application of proper management. Inspection of growing plants for disease detection is commonplace using machine vision systems. To detect diseased leaves and stems, image processing can be utilized. It can also be used to identify the damaged area, as well as assess whether the affected area is a certain color. The use of image processing to detect plant illnesses automatically improves pest detection and disease management recommendations. The various techniques used include image processing for object detection, feature extraction, and pest identification based on various parameters such as color, boundary, background color, foreground colour and pixel intensity. Various papers have been published explaining the various techniques used. Our goal in reviewing pest identification papers was to gain a good notion of the strategies that are effective and beneficial.

Figure: 1 Aphids on leaf

Figure: 2 Whiteflies on leaf

II. Literature Review

An incremental back propagation neural network (IBPNN) and a correlation-based feature selection (CFS)-based automatic classification system for tea insect pest detection is described in this study. It is clear that a smaller feature set can have some advantages, provided that the intelligent system's performance is not harmed. CFS is used to reduce the number of features. After that, an incremental back propagation learning neural network classified the data based on the original and reduced feature sets (IBPLN). authors then compare the two sets of data. This research shows that CFS can be used to reduce the feature vector and that CFS+IBPLN can be combined to solve various classification issues. [1]

Diseases reduce plant productivity. As authors result, the plant's growth is constrained, and it loses quality as well as quantity. The most effective way to identify and diagnose sickness is through image processing. Many qualities, including as colour, texture, and form, can be recovered when the contaminated area is discovered. Last but not least, a categorization strategy is utilised in the search for sickness. Many different feature extraction approaches are employed in order to extract colour, texture, and edge data, including colour spaces like RGB, colour histograms, Gabor filters, and edge detectors like Canny and Sobel. Support vector machines, neural networks based on radial basis functions, backpropagation networks, probabilistic neural networks, and support vector machines are a few categorization methods. Image processing has been proposed and has proven to be effective in identifying plant diseases. This study discusses a variety of image processing methods for a wide range of plant species in order to detect plant diseases. [2]

Image processing and neural network approaches can be utilized to accurately and successfully detect and categories illnesses in diverse plants. This research examined a number of previously employed methods. Techniques like segmentation, feature extraction, and classification are all a part of these processes. Different plant diseases have been accurately identified and classified using these methods. However, present techniques still have room for development. Image processing approaches used to detect plant diseases are examined and compared in this paper's primary goal. The vast majority of India's people makes their living through agriculture, as is well known. It's critical to put effort into farming with new technologies to make people's lives easier and more comfortable. Crop output can be greatly improved by implementing modern technologies. Automatic plant disease identification using image processing and neural network approaches can be utilised to solve disease problems in plants and crops. Plants are susceptible to a wide range of illnesses. [3]

In order to determine the performance of the data, image processing was used to assess and classify leaf illness using an Artificial Neural Network. On 100 leaves, the image processing method was used to analyze data based on colour and unhealthy areas. Using image processing, the goal of capturing and analyzing data from leaf photos to classify healthy or unhealthy medical plant leaves was realized. To extract an image and obtain data, image processing algorithms such as contrast adjustment, segmentation, and feature extraction are utilized. The three methods discussed here are all part of the category of image processing. A neural network was used to analyze the findings of the experiment. There are two types of neural networks used to classify leaves: healthy and unhealthy: multi-layer feed forward and radial basis function RBF. [4]

In this study, a machine vision system was used to assist in the sickness identification gadget. A back-propagation ANN model with three layers was used to identify P. cubensis and S. fuliginea on infected leaf images, and the results showed that the system's ability to distinguish between the two was satisfactory. Businesses might benefit from using real-time sickness detection technologies that are equipped with artificial intelligence (AI). Detecting fungal infections on plants' leaves might be possible with a multi-sensor system that includes an artificial light source and a mobile multi-sensor platform that roams crop fields. This. To increase the detection skills of intelligent farmer assistant robots for a wide range of fungal and viral illnesses, phytopathologists and agrotechnology engineers must carry out additional research. [5]

This study examines various disease classification strategies for plant leaf disease detection and an algorithm for image segmentation methodology that may be used to identify and classify plant leaf diseases automatically in the future. This algorithm has been tested on 10 different plant species including bananas, beans and jackfruit. As a result, relevant plant diseases were collected for testing. The best results were achieved with minimal computational effort, demonstrating the efficacy of the proposed method in identifying and classifying leaf diseases. Using this method also has the advantage of allowing for the early detection of plant diseases. Fuzzy Logic and hybrid methods can also be employed to improve the classification process's recognition rate: Artificial Neural Network, Bayes classifier, Fuzzy logic, etc. [6]

ANNs were thoroughly reviewed in this article, and their forecasting abilities in terms of stock indices (or stocks) and exchange rates were compared. Because it is a feed forward multilayer network with non-linear node functions, the MLP is a widely used network in the financial services sector. Thirty pieces of literature have been analyzed in order to back up this claim. Authors discovered that more than 40% of the evaluated studies support or at least are on par with the proposal networks in terms of MLP's performance. The MLP, on the other hand, has substantial restrictions in terms of network architecture, fundamental functions, and initialization weights. [7]

In many parts of the world, lack of infrastructure makes it difficult to detect crop diseases rapidly, putting food security at risk. Smartphone-assisted disease detection is already a reality, thanks to increasing smartphone penetration around the world and recent advances in computer vision made possible by deep learning techniques. Using a publicly available dataset of 54,306 pictures of injured and healthy plant leaves taken under controlled conditions, we trained a deep convolutional neural network to recognize 14 crop species and 26 illnesses (or absence thereof). In a held-out test set, the trained model's accuracy is 99.35%. This shows the strategy is viable. On increasingly large and publicly available image datasets, deep learning models can be taught to diagnose crop diseases more widely using smartphones. [8]

Accurate disease detection is essential for successful crop cultivation. As can be seen from the explanation above, image processing techniques have proven to be beneficial in a variety of contexts. Using all of the aforementioned strategies, we can accurately detect and categories illnesses in a wide variety of plants. K-means As a result, Neural Networks and clustering to detect infected objects are frequently employed to improve the accuracy of disease detection and classification. Because of this, these methods have use in an Agrobot system. [9]

Cucumber crop diseases are being studied by collecting leaf samples. Cucumber crop disease is being diagnosed and treated as part of the work being done. This study examines the diseases downy and powdery mildew in cucumber crops. Texture features are extracted using the GLCM and first-order statistical moments. MATLAB 7.10.1's neural network toolbox is used for classification. Classification accuracy is provided by the system at 80.45%. The method provided here can be used with a wide range of crops. In contrast, the system must only use attributes for other crop types if they are capable of reliably classifying the illnesses of those crops. Additional texture properties will improve categorization accuracy in the future. It's also possible to extract texture features using the Gabor filter. [10]

III. Mechanism of neural networks

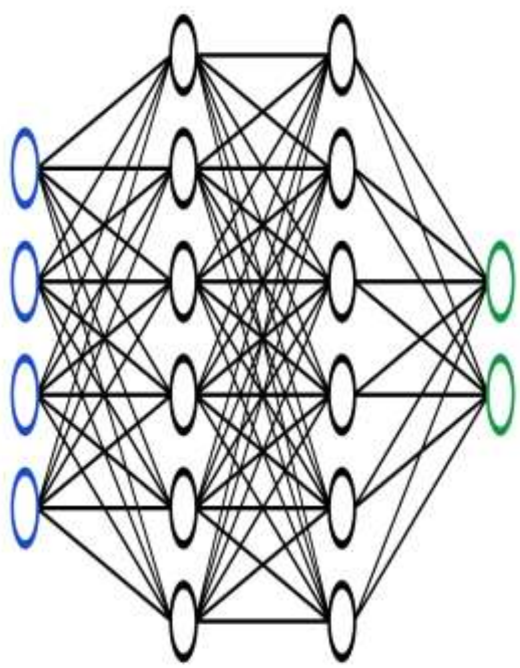

Figure: 3 Neural Network

Mathematics has been utilized in data mining to create neural networks (NNs). NNs are fundamentally a network of nodes interconnected in a way similar to the brain's massive network of neurons. Each node allocated to an Artificial Neural Network (ANN) represents a neuron in a natural neural network. Synapse connections allow neurons to receive messages from other neurons of the same type. Perceptrons are the processing units that connect each neuron to the rest of the brain. Neurons are critical nodes in a network because they take and process inputs while also producing outputs. Connecting two neurons often carries the weights that encode electrical information implicitly. To make the networks learn, generalize, imagine, and create relationships inside the network, electrical information is used to replicate specific values contained in weights. In 1943, McCulloch and Pitts proposed the first ANN model. An "element of computation" used in this model was the Mc-Culloch-Pitts neuron. Since then, numerous academics have been motivated by this concept to develop rapid computing models that behave similarly to the human brain, giving them the name artificial neural networks (ANNs). This is the opposite of how neural networks (NNs) work, which is that they transmit information from their input to their output in reverse order (from their input to their output). The concealed layer is like a 'black box,' and it might be difficult for the human brain to decipher. As long as ANNs have had this flaw, they've been a roadblock to adoption.

IV. Early disease detection

When crop disease is detected early and non-destructive approaches are used, human engagement in plant protection can be reduced. Early illness detection has made use of a number of NN approaches. To detect and diagnose plant diseases, NNs' learning skills come in handy. Every weight and bias in the model must be adjusted according to the allocated layers if a disease diagnosis is to be effective. Effective disease control necessitates early detection and precise diagnosis of plant diseases. Hyperspectral data and NN models used together have made early detection and diagnosis of plant disease possible in recent years. Visual scouting, on the other hand, is still a primary method of inspecting illness symptoms early on. Using hyperspectral sensors, it may be possible to detect and diagnose disease without causing any damage to the body. The introduction and incorporation of new methodologies (i.e. imaging and non-imaging spectroscopy) to complement molecular, serological and microbiological techniques like ELISA and RT-PCR on a laboratory scale are required to achieve reliable early detection and diagnosis of plant diseases in order. Resources such as time, money, and specialized labour have been a problem for these methods. Laboratory conditions must be tightly controlled and free of contamination, on the other hand. Despite this, there is still a significant discrepancy in destructive versus non-destructive diagnostic methods.

Comparison of Classification Techniques

Technique	Advantages	Disadvantages
“K-nearest neighbor(KNN)”	“Simple implementation”	“It is lazy learner. Computationally expensive”
“Radial Basis Function”	“Trains faster, Hidden layer is easy to interpret”	“It is slower in execution”
“Probabilistic Neural Networks”	“Tolerant of noisy inputs”	“Long training time”
“Back propagation network”	“Simple implementation”	“Slow and inefficient”
“Support Vector Machine(SVM)”	“Less over fitting, Robust to noise”	“Computationally expensive”

Table: 1 Comparison of Classification Techniques

V. Network training and learning

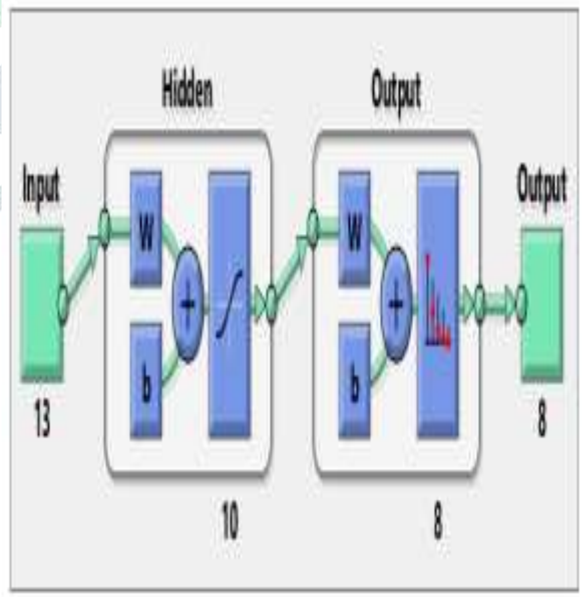

Figure: 4 Trained Artificial Neural Network

It is difficult to collect samples from a variety of plant diseases and pests that must be visually identified manually (positive samples). Because most existing methods of plant disease and pest detection utilizing deep learning are supervised learning approaches that involve large numbers of plant disease and pest samples, unsupervised learning needs to be investigated. Deep learning is tough to grasp because it's a mysterious black box that relies on a large number of labelled training examples in order to work. Since it's important to have a human-like visual cognitive model for network training, research should also focus on strategies to use prior knowledge of brain-inspired computing. As a result of their memory requirements and extended testing times, deep models are inappropriate for use on mobile devices. Simplifying and streamlining models while maintaining accuracy are essential goals. Finally, one of the most difficult parts of applying a deep learning model to new problems is determining which hyper-parameters to use. There's a lot riding on these hyper-parameters, and even a minor modification might have a big impact.

VI. Classification using artificial neural network for pests

Data mining techniques such as neural networks (NN) are used to classify and cluster large amounts of data. Composing and copying the brain's functions is the goal of this computer experiment. NN learns via comparison the majority of the time. Classifying and even recognizing new trends or patterns of results should be possible if NN is provided with enough examples. A basic NN has three layers: input, output, and hidden. The input layer's nodes are linked to the hidden layer's nodes, allowing for a large number of nodes on each layer. The secret layer's nodes are connected to the output layer's nodes. One of the most challenging areas of artificial neural network research and development is classification (ANR). The weights of the nodes are represented by these links. There is a major issue with using ANN to categories data sets that have a growing number of features and sets: instruction, learning, and transition.

VII. CONCLUSION

New methods based on deep learning combine them into an end-to-end feature extraction with great development potential for jobs such as illness and pest identification that are currently handled by standard image processing methods that include a number of steps and connections. A long way remains to be covered in order to fully integrate plant disease and pest detection technology in a natural setting. There are also some hurdles that must be overcome. Agricultural disease analysis and pest identification is the subject of this research. It looks at the possibilities. This paper examines a variety of image processing algorithms for spotting pests and spotting plant diseases. The image processing method proven to be an efficient agriculture-specific machine vision system. Data mining has traditionally been the primary use of NNs, however new applications utilizing hyper spectral data suggest that they can also be utilized for illness detection. NN researchers, like those working in a wide range of other fields, have had to deal with new problems as they arose. Pre-symptomatic, symptomatic, and asymptomatic diseases can all manifest in a single plant, which necessitates the use of the best trainer sets in order to accurately classify them. With hyper spectral data, NNs have demonstrated tremendous adaptability to novel illness diagnosis issues.

VIII. References

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