IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁒ Impact Factor 8.102 ⁒ Vol. 12, Issue 4, April 2023

DOI: 10.17148/IJARCCE.2023.12481

ANALYSIS AND DETECTION OF PLANT LEAF DISEASE USING NEURAL NETWORK

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Abstract: To boost plant growth and output, farmers need automated disease monitoring of plants rather than human monitoring. Many plant diseases have the potential to cause significant losses or possibly no harvest. Anthraconose, bacterial blight, cercospora leaf spot, and healthy leaves were the subjects of this study's focus on several alterneria alternata diseases. We apply three stages of clustering on the initial image filtering. As a result, we developed a modern technique in this study to detect diseases linked to both leaves and fruits. We overcame the shortcomings of the conventional eye monitoring method by using a digital image processing methodology for rapid and accurate plant disease identification.

Keywords: Convolutional Neural Network (CNN), Support Vector Machine (SVM), Confusion matrix

I. INTRODUCTION

For speedy crop production, early plant disease identification is crucial. Crop output and quality can both be impacted by plant diseases like blight, leaf spot, black rot, bacterial spot, and others. Farmers occasionally use costly methods and the use of pesticides to lessen the consequences of these illnesses. Chemical methods are bad for the environment, the plant, and people's health. Farmers also suffer huge financial losses as a result of these conditions due to higher production costs. If you want to control this condition, you must catch it early. In agriculture, spotting plant diseases with the human eye is a common practise. In this study, we can investigate plant illnesses that affect the leaves. These days, it's commonplace to see a computer analysing photos taken in a field. These photos can be used for a number of tasks, including the detection of weeds, the classification of fruits, the investigation of insect counts, and the examination of plant genetics.

Technique learning is a prominent topic right now. Deep learning is the most sophisticated artificial intelligence technique because it replicates how the human brain learns. Convolutional neural networks (CNNs), a sort of deep learning model, have found widespread use in the field of image processing. Conventional approaches often use semantic features as a categorization tool. Sorting the leaf feature data into categories is the task at hand.

presents a hybrid model that uses CNN to learn the characteristics of leaves. Data collection, data cleaning, and photo categorization are the three main components of the study's approach. The Plant Village dataset, which includes types of tomato, maize, apple, grape, potato, and sugarcane plants, was used in the research. The study includes images of healthy plants that have been shown to have 11 different sorts of plant illnesses. Images must be resized and enhanced before being submitted to a classification system. Sustainable agriculture and the difficulties of disease prevention are related. Inappropriate use of pesticides may make diseases harder to treat and result in long-term resistance.

Precision agriculture refers to the quick and accurate diagnosis of plant diseases. Accurate and timely illness identification, including early prevention, has never been more crucial for preventing the loss of money and other resources and achieving healthy production in this changing climate. There are several methods for determining the presence of plant diseases. When there are no obvious signs present or when it is too late to take preventive action, it is imperative to perform a thorough and sophisticated examination. Because diseases frequently manifest themselves subtly in the visible spectrum, an eye exam done by a skilled practitioner is the primary tool utilised in practise for identifying illness. In order to accurately diagnose illnesses, a plant pathologist must be skilled at observation and be able to spot the disease's telltale signs.

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Neural networks, also referred to as connectionist systems, are a type of computational model used in computing and other research fields. They are based on a large number of neural units (artificial neurons), and they solve problems in a manner similar to how the human brain does so by using large clusters of biological neurons connected by axons. Each neuron is a part of a wide network of other neurons, and these connections can either be supportive or inhibiting, depending on the circumstance.

the varieties of neurons involved. Each neuron may have the summation function, which averages the numbers that enter the brain. It's also feasible that each component of the unit, as well as the unit itself, has a function or acts as a barrier that the signal must pass through in order to travel to surrounding neurons. Because they are taught rather than explicitly written, these systems perform best when the reaction or feature identification is difficult to convey within the context of a typical computer virus. The signal path runs from front to back in neural networks since they are frequently multilayered or cubic in shape. Back propagation is the process of using forward stimulation to change the weights on the "front" neural units. The balance between stimulating and inhibiting connections is a little more variable in contemporary networks. Dynamic neural networks are the most sophisticated ones; they may create new connections and even neuronal units while also shutting down less important ones according to rules. While some neural networks are more abstract than others, all neural networks ultimately aim to solve problems in a manner that is comparable to that of a human brain. In spite of the fact that many modern neural network projects use hundreds to millions of neural units and many connections, they are still far less complex than the human brain and closer to having the processing power of worms. Findings from contemporary neuroscience research are regularly used as a motivation for developing novel neural network topologies. A recent development is the use of connections between neurons that extend beyond their close neighbours and cross numerous levels of processing. Many different signals are transmitted by axons over time, and some research on the issue use techniques like deep learning that extrapolate complexity beyond a simple on/off set of Boolean variables. An input can be any number in the range between 0 and 1. In addition to weights being applied to each input, the neuron has a general bias. The weights, which are actual values, represent the inputs and the extent to which they are pertinent to the result.

II. IMAGE PROCESSING

In order to improve the quality of the final image, it is customary to undertake a number of pre-processing procedures. These procedures entail the elimination of reflections, the adjustment of the strength of the individual particle pictures, the removal of low-recurrence foundation noise, and the blocking off of specific regions of the image. Pre-processing images is one method for raising the data's quality. As part of the pre-processing procedure, an additional square was added around the leaves to call attention to the area of mystery (plant leaves). photos with a lower bar and measures that aren't exactly 500 pixels were disregarded as relevant during the collection of the photos for the dataset.

Additionally, for the purpose of collecting data, only images that clearly showed the area of interest were used. Images were carefully checked to ensure that they had all the information needed for highlight learning. Even while a thorough Internet search may turn up a tonne of information, evaluating its veracity is not always simple. Horticultural experts looked at pictures of leaves and assigned an illness abbreviation to each one after becoming concerned about the validity of the classifications in the dataset, which had been previously constructed via a catchphrases search. For the training and validation datasets, well characterised photos must be chosen. This is the only way to produce a reliable identification model. In this stage, duplicate images that remained in the dataset after the first focus on grouping and categorising images were removed.

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III. TRANING IN NEURAL NETWORK

It was suggested to build a model for identifying photographs using a deep convolutional neural network setup utilising a data set. The open-source software Tensor Flow carries out calculations using data-flow graphs. The hubs of the diagram represent numerical processes, while the edges represent shared multidimensional data.

As part of the Google Brain Group, the company's machine intelligence research department, Google's scientists and designers developed Tensor Flow in order to further the company's efforts in artificial intelligence (AI) and deep neural network (DNN) study. The framework, however, is sufficiently all-encompassing to be useful in a variety of other disciplines as well. A feed-forward fake neural network called a convolutional neural network borrows connections from the animal visual cortex in order to function as artificial intelligence. Individual cortical neurons only fire in reaction to changes in the response field, a confined region of space. To tile the visual field, the response fields of several neurons only partially converge. Convolutional activity quantifies the response of a single neuron to enhancements in its full broad field. Multilayer perceptron types called convolutional networks were developed that require the least amount of pre-handling adjustments. They were motivated by the cycles of nature. They are frequently employed in systems for visual identification and recommendation as well as the teaching of fundamental linguistic abilities. Active fields in convolutional neural networks (CNNs) are dispersed throughout numerous layers. These are little clusters of neurons that repeatedly display particular informational segments. The outputs of these collections are then tiled so that their information districts overlap, resulting in a more accurate representation of the original image. Each successive layer goes through the same procedure. The ability to tile helps CNN keep their own perspective on the news scene.

IV. METHODOLOGY

The majority of people in India depend on farming for their livelihood. When growing crops, many farmers encounter difficulties, such as faults in the leaves. The illness must be identified before any preventive measures may be performed. Currently, visual examinations of farms are used by farmers and professionals to detect plant leaf diseases. The high cost of people is due to the requirement for a sizable workforce to run the system and the continual monitoring of plants when the land is too large. As was already established, farm visual surveillance is time-consuming and ineffective. As a workaround for this problem, image processing techniques are used to identify leaf diseases; however, as of yet, there is no adequate programme to correctly categorise the leaf after its photographs have been captured and its attributes have been discovered.various plant diseases can be categorised using a wide range of various leaf morphologies. Fuzzy logic, principal component analysis, and the K-Nearest Neighbour Classifier are just a few of the countless methodologies. The leaves of 24 various plant species were used to create these labels, which include those for apples, grapes, potatoes, and tomatoes. A label for an apple might read, "Healthy," "Scabbed," "Rotten," or "Infected."Grey spot, corn blight, corn rust and corn health must all be specifically included on the label for Corn Cercospora [11], [13]. Only a few grape diseases, such as black rot, Esca, healthy, and leaf blight, might be included on the labels. Early blight, healthy, and late blight potatoes are the three varieties. Common diseases and pests that could harm tomato plants are listed on the label.There are 31,119 total photographs in the collection, all of which depict apples, corn, grapes, potatoes or tomatoes. There are 24,000 different photos used. Following that, the training and testing datasets are divided 80/20, with the reduction of each image to 256 by 256 pixels. The next step is to train the CNN model.

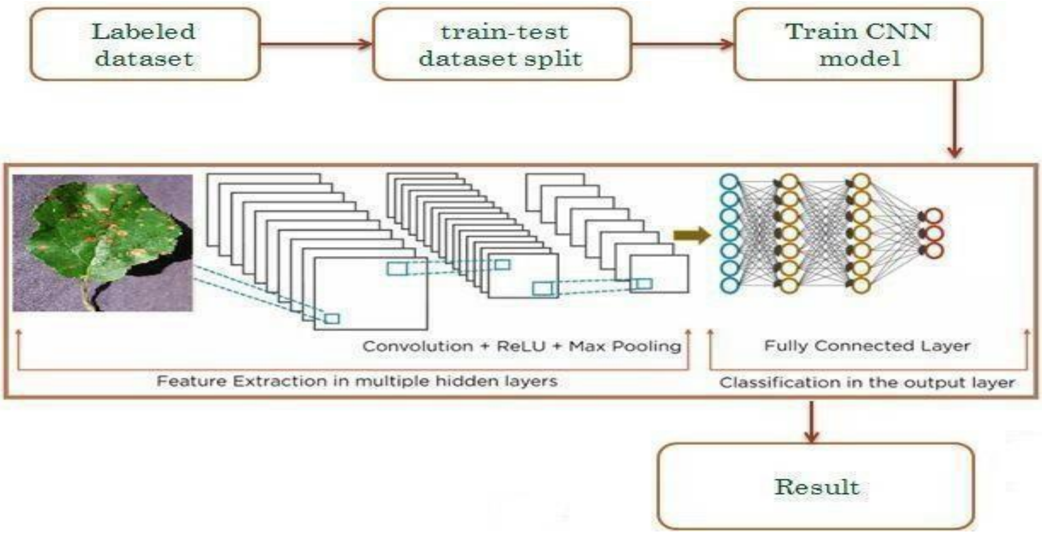

Fig. IV (a): Proposed workflow of the overall system

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Construct a convolutional neural network-based computer model (CNN) that can accept a collection of unlabeled images as input and return labels that correspond to the data in those images.classification. They are a multi-layer neural network that can learn the features used in classification with enough training. Since it requires less human inputs than traditional methods, autonomous feature extraction is more successful. For identifying leaf diseases, an adaption of the LeNet architecture might produce the best results.

In comparison to other CNN models, LeNet is straightforward. Layer using this approach. The LeNet model classifies leaf diseases using image capture. The new convolution, activation, and pooling layers in this version expand upon the capabilities of the original LeNet design. Figure 2 displays the model used in the paper.

Each unit contains a convolution, an activation, and a max pooling layer. In this architecture, three of these building blocks are utilised, followed by fully-linked layers and soft-max activation. We use fully connected layers for classification, whereas convolution and pooling layers are used for feature extraction. The activation layer lessens the linearity of a network when it is used. Utilising the convolution layer, the convolution method is utilised to extract features.

IV.(a) Image Acquisition

Using a camera to capture a real-world scene is known as image acquisition. In the modern world, using a virtual camera to take images is a common practise. But there are alternative approaches that can be used. photos for this project are retrieved from the plant village dataset, which enables the training and testing of a set of rules as well as the retrieval of photos.

IV.(b) Image Preprocessing

Pre-processing can be used to improve the image quality before additional processing or analysis. Shade space conversion, image improvement, and smoothing are all features of the software. By correcting for distortion, one can take amazing pictures. Increasing a picture's contrast is one of image enhancement's primary goals. Images are cropped to participate in a specific event. Smoothing out clear areas is a frequent photography technique.

IV.(c) Image Segmentation

"Image segmentation" is the process of separating a picture into its component pieces. It is simpler because there are three different types of image segmentation:1. primarily based on edges
2. Completely based on location
3. Clustering partially based on
To complete picture segmentation in this method, clustering is entirely dependent. Clustering is used to divide the records into a predetermined number of homogenous agencies. The segmentation system is designed around a number of the image's capabilities. This may be a component.

IV.(d) Feature Extraction

The correct location of the infection can only be determined through the extraction of characteristics. A key part of feature extraction is reducing the time and effort needed to characterise huge datasets. It's a method for analysing images to identify a useful set of characteristics that might be used to evaluate and classify a large amount of data. The incoming data is analysed to determine the statistics that would best represent.

V. CLASSIFICATION OF DISEASE

Image categorization is carried out using support vector machines (SVMs), a family of interconnected supervised learning techniques that are often employed for classification and regression.

Sections of the data are separated for instruction and evaluation. The co-occurrence potential of the feature values for the leaves is used to evaluate the SVM, which is trained using 80% of the training data for the category phase.

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VI. EXPERIMENTAL RESULT

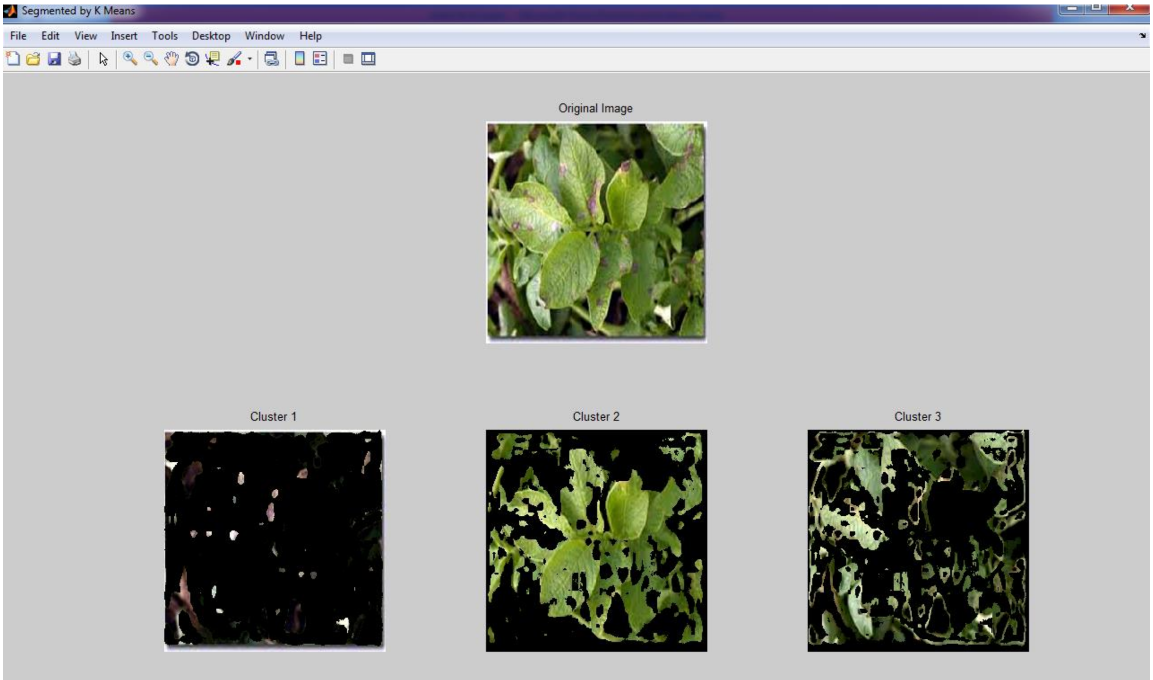

Fig. VI. (a): Clustering of Image

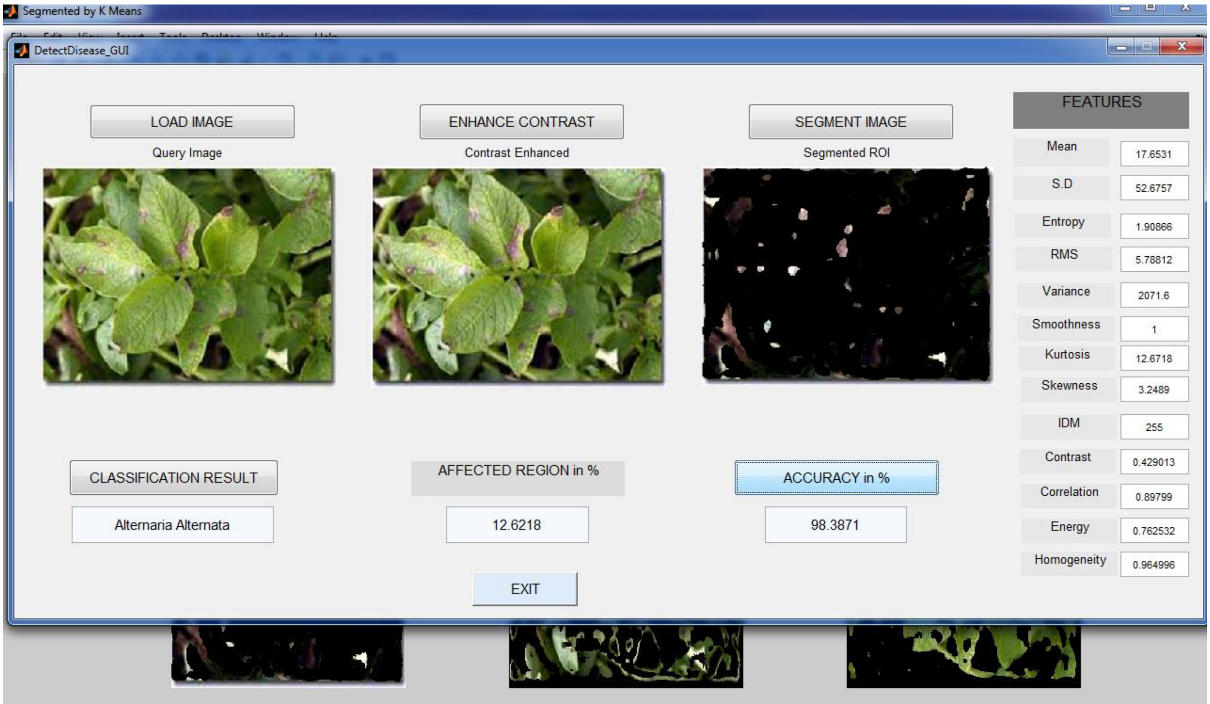

Fig. VI. (b): GUI Result

VII. CONCLUSION

Crop agriculture is one of the most important sectors in the world since it satisfies a basic demand for food for everyone.For the agriculture sector, early detection and treatment of these illnesses are essential. This study aims to create a convolutional neural network capable of identifying unusual plant species and diseases. The tested model may be applied to tests for real-time image-based disease recognition and detection in plants.

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In order to properly prepare the trained models for usage in practical applications, it may be necessary to expand the present dataset in subsequent research to include more plant species and more plant diseases. Different learning rates and optimizers could be used to assess the effectiveness and precision of other CNN architectures.

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