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Precision Agriculture for Accurate Cotton Leaf Disease Classifications through Advance Deep Learning Techniques

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Abstract:

Artificial intelligence includes deep learning as one of its subsets. It is an example of machine learning and artificial intelligence that aims to mimic human learning processes for certain domains. Building a convolutional neural network–based deep learning model that can differentiate between damaged and healthy leaves is the main objective of this study. Researchers and practitioners in the field have paid a lot of attention to it in recent years because of its helpful qualities in learner autonomy and feature extraction. In the collection you may find both healthy and decaying leaf images. Applications in computational linguistics, audio/video processing, image/video processing, and similar domains are extensive. Plant disease detection and pest range assessment are two areas of agricultural plant protection research that have flourished at this location. Some of the present-day challenges and difficulties that need resolution have also been covered in this research. The following library packages have been used: KERAS, MATPLOTLIB, NUMPY, and OPENCV.

Keywords- Dead leaves, Artificial Intelligence, Color Analysis in images, Feature Extraction, Deep Learning

INTRODUCTION

The global food supply is jeopardized, and smallholder farmers' economics take a major hit, when plant diseases proliferate. More than 80% of the total agricultural output in the developing world comes from smallholder farmers, and it is usual to hear predictions of crop loss of more than 50% due to pests and diseases. [15] Many initiatives have been set up to help smallholder farmers, who make up a substantial portion of the world's hungry population and are particularly vulnerable to diseases caused by pathogens. [16] Insecticides have been mostly replaced in pest control efforts during the last decade by integrated pest management tactics. The key to successful illness management, regardless of approach, is early and accurate diagnosis. [17] A role in disease detection has traditionally been undertaken by local plant clinics and agricultural extension programs. By taking advantage of the exponential growth in Internet use throughout the globe, these programs have recently benefited from the availability of online assets for illness diagnosis. [18] in In recent years, a multitude of mobile phone tools have surfaced, capitalizing on the extraordinary global usage of cell phone technology. It is tedious, incorrect, and impracticable to visually diagnose plant diseases except under certain

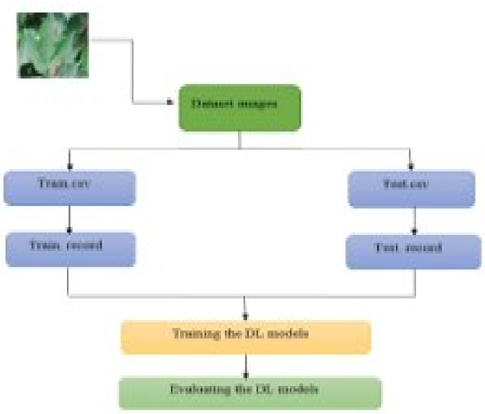

Fig 1: Flowchart of Training Pipeline

The ongoing surveillance system can perhaps be useful in the battle against infectious diseases. categorization, with the most important finding being plant disease. Educational field that is associated with agriculture. A wide variety of options and operational prototypes have been investigated by researchers, along with deep learning stages. Effects of ICT on information are the main subject of this work. We will be collecting, analyzing, and training on four types of data: images for illness diagnosis, brown spot detection, hispid, leaves attack, and wellbeing

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Volume 13 Issue 02 2025

assessment using deep learning. This article takes a look at the several ways plant diseases are classified. After being trained with a large sample of photos of both healthy and sick plants, the CNN-based network may be used to forecast plant illnesses using photographs of plants.

LITERATURE SURVEY

When applied to jute plants, the suggested technique shows great promise for the early detection of stemcentric diseases. diagnosis of plant diseases by palpation of affected areas and identification of specific illnesses The procedure of diagnosing an illness typically consists of four basic steps: The input RGB picture undergoes a color transformation structure before a threshold is used to selectively exclude green pixels. [1] An article titled "Identification and Categorization of Leaf Using Artificial Neural Network" explored the possibility of using photos of diseased leaves to identify certain plant diseases. Careful feature value selection trains an ANN to distinguish between healthy and sick samples. The accuracy rate of the ANN model's predictions is about 80%. Calculating statistics yields useful pieces [2]. A classifier takes the gathered information and uses them to place the illness into one of several predefined groups. the third Deep Neural Networks are used to identify and classify plant leaf diseases. Using a Deep Learning strategy, we classify plant illnesses found in photos of leaves and present them in this research. In this research, we train a convolutional neural network called YOLOv3 using ResNet18 models such that it can identify leaves in images. This article uses deep learning methods to classify cotton leaf diseases. This work uses the LeNet structure, a neural community architecture, to achieve this goal of picture classification. Deep Residual Image Recognition (4th Edition): [5] Here, we provide a residual learning framework that is more thorough than what was already on the market. Instead of analyzing additional, unexplored aspects, these models rework the layers to concentrate on examining residual features and how they relate to the layers' inputs. Deep neural networks are useful for classifying plants on a large scale [7].

We talk about how to classify flowers using deep learning algorithms, how to use it to monitor biodiversity on a broad scale, and how to classify plants with improved accuracy utilizing setups with convolution layers, such as 50 iterations. [8] Methods for detecting illnesses in plant leaves using segmentation and soft computing: To categorize and diagnose leaf diseases, this article employs image analysis using a segmentation approach, which is based on a specified set of criteria. This research aims to provide a method for plant leaf classification using a probabilistic neural network. The eleven leaf characters have been compiled. CNN achieved a performance level of above 90% after being taught to distinguish between 32 distinct flower varieties and 1800 distinct leaf types. These models outperform a generic CNN version in terms of precision while requiring less training time to deploy. This report discusses many frameworks that raise participant representation on the board by using numerous innovations. Despite CNN's great standard overall performance and extensive use in visual facts problems, its implementation guidelines are severely lacking. Due to CNN's shortcomings in representing viewpoint invariance and the information loss that occurs when data is routed via its pooling layers, a novel class of neural network representations known as the tablet community has arisen as a potential replacement. Part III: The Current Setup Because of ANN models, the human brain's complexity is much decreased. An artificial neural network (ANN) uses computing units called artificial neurons that are supposed to mimic the way the nervous system works in the body. Input, hidden, and output are the three primary components of an ANN model. The neurons in the (n+1)th layer get a signal from the neurons in the nth layer. There is a predetermined weight for each connection. The output is the product of all inputs multiplied by their respective significance. An activation function is used to feed the output into an ANN during construction. There are a lot of technical and scientific problems that the ANN might help solve. As a result, ANN has a wide range of potential applications [3] such as jpeg, mathematical and statistical models, stock market prediction, diagnostics, and signal processing.

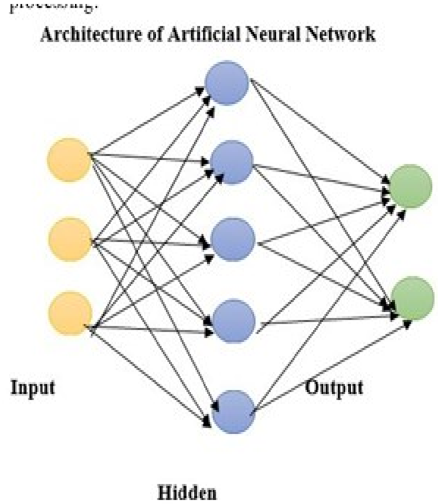

Fig 2: Basic Diagram For ANN

Some of the problems with ANN include the following: • The computational power required by Artificial Neural Nets is high; • The models of these networks are hard to explain; • Neural networks require massive amounts of data for training; and • Careful data planning is required for neural network models.

PROPOSED SYSTEM

The agriculture industry is the engine that propels the economy. The agriculture industry employs about half of India's workers. India is well-known for its abundant production of several ingredients, including photons, rice, cereals, ingredients, and spice items. If farmers can keep their plants healthy and harvest a sufficient amount of food, their wealth will rise along with the worth of their commodities. Therefore, the capacity to detect plant diseases is of utmost importance in the field of agriculture. In many cases, farmers' attempts to protect biodiversity are unsuccessful because plant-killing diseases are so common. To find plant illnesses early on, it is beneficial to use a completely automated disease detection system. There are a number of ways in which plant illnesses may show themselves; symptoms can be seen on the leaves, stems, roots, and so on. Manually diagnosing plant diseases using leaf photos is a time-consuming and tedious task. The development of new computational approaches is necessary to automate the process of disease identification using photographs of leaves. The Tensor Flow Library Interface, also known as Matplotlib, and Keras, are tools for creating graphs and pictures. Python module (for working with arrays with many dimensions) • OpenCV (Graphical Processing Tool) To ascertain if the leaf is healthy or diseased, some tests must be performed. such as Cleaning Up Data, Extracting Features, Training Classifiers, and Finally, Classification. When working with photographs, "preprocessing" entails standardizing the file sizes of all the photos. After the picture has been pre-processed, the next step is to extract features using an algorithm. When gathering the photos, four types of diseases were taken into account. Availability of visuals was low. We have enhanced the data using Matplotlib as deep learning-based approaches need more photos. This approach creates 10 identical clones of the initial picture in a single pass. This results in a deluge of data that may be used for model improvement. Keras, OpenCV, Numpy, matlab, and vector flow are just a few of the data science libraries that our team has used.

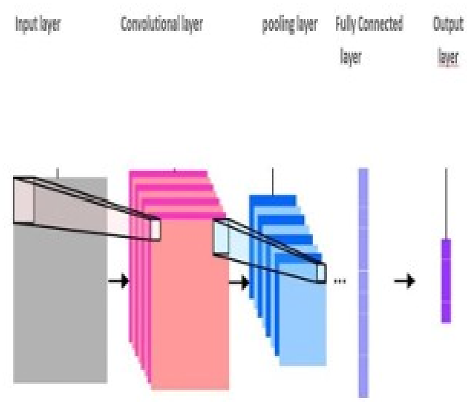

Fig 3: Layers Of CNN To build the Keras model,

sequential modeling was used. The model's design includes two conv2D layers. On the coLab server, you may find the data. As it travels, the route variable will look at each picture in turn. Using the OpenCV library, every image is decoded. Dyadic image processing is then used to decrease the picture sizes. In addition to other meta data about the photographs, the Class of each photo is retrieved from their filenames and placed in a label variable. Prior to training the model, the label lists and input data are converted into Numpy arrays. Not only is the test 25% longer, but the data train is 75% longer as well. When using enhanced data obtained from live instances. The picture is 128x128x3 pixels in size, and the classifier is provided with data pertaining to four categories.

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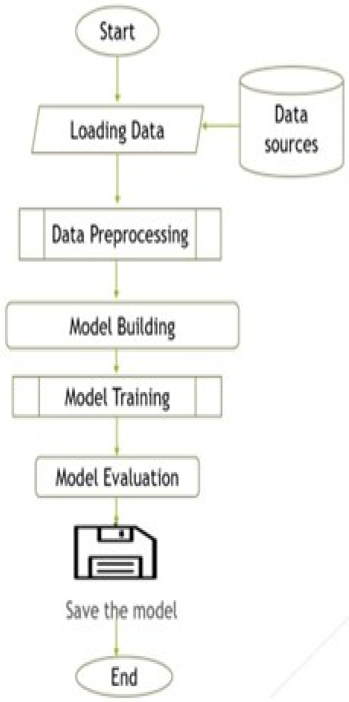
Volume 13 Issue 02 2025



Digital photographs are subjected to pre-processing, also known as image processing, before to being captured. This is accomplished with the use of computer programs. It is necessary to use a certain algorithm to the visual analysis process in order to locate the plant. When it comes to images, Obtaining the data from a publicly accessible database is the first step. investigation and identification, we use a comparable strategy and utilize the same method. Due to the critical nature of the image quality in this process, we cannot use an algorithm that is dependent on a fuzzy image. Digital images may undergo image editing, often called image enhancement, to improve their screen appearance or make them more suitable for further processing. You may use any of the following to improve a picture: As an example, filters may aid with noise reduction, heterogeneity correction, stretch, decorrelation, unsharp mask filtering, and more. The phrase "image segmentation" describes the steps used to break down a large digital picture into smaller, more manageable pieces, or "objects" made up of individual pixels. Image analysis and identification are both made much easier by first breaking images down into its component pieces and then analyzing each item separately. In terms of intensity and texture, it's not unusual to see a similar thread throughout all of the subgenres. Next, gather the input test picture, do any required pre-processing, and lastly, transform the image to array format so it can be analyzed. Each database is pre-processed, partitioned, and renamed correctly after being chosen. Then, it is put in its designated directory. Once the model has been trained correctly, CNN sorts the data. The program will reveal the disease and therapy possibilities if the plant is affected after the image and strong proof have been connected.

is available in CoLab on the server. As it travels, the route variable will look at each picture in turn. Using the OpenCV library, every image is decoded.

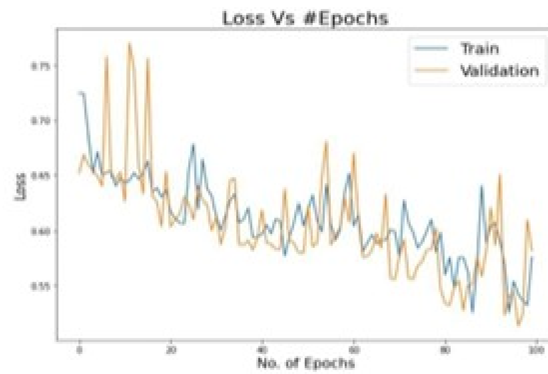


Fig 5: ANN model graph for loss vs Epochs

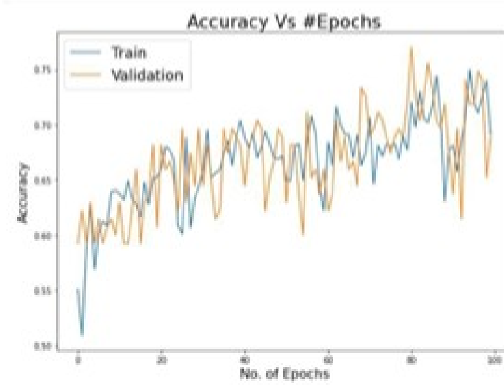
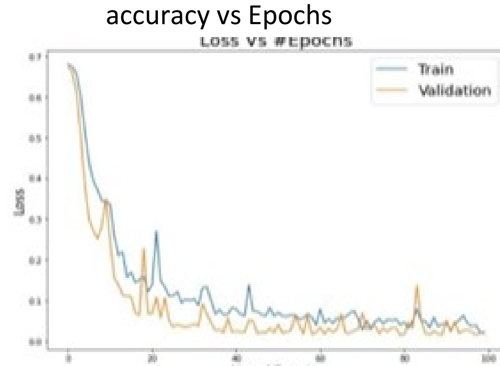


Fig 6: ANN model graph for accuracy vs Epochs



ISSN NO: 9726-001X

Volume 13 Issue 02 2025

Fig 7: Feature Selection Accuracy level

RESULTS

An Accurate ANN Model: • Accuracy in training after 100 iterations: 66.21% • After 100 iterations, validation accuracy is 68%.

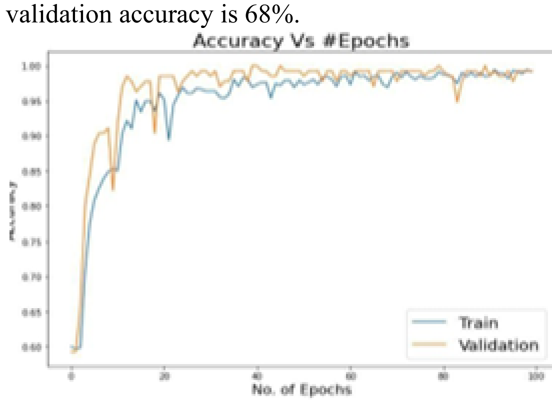


Figure 8: Accuracy vs. epochs feature extraction graph of the CNN model Precision degree: The following graph shows that when compared to the existing model, the overall accuracy of feature extraction will be rather low:

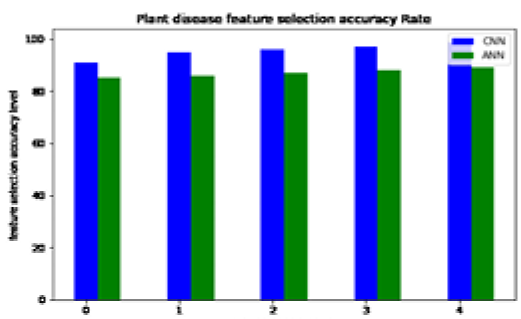


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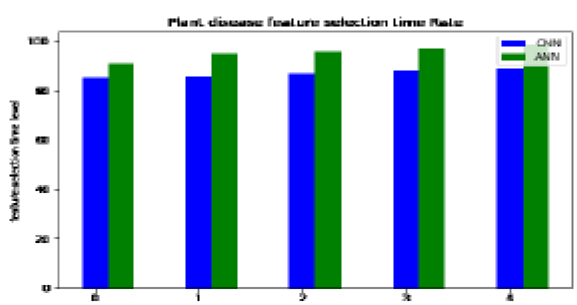
Fig 9: Feature Selection Accuracy level



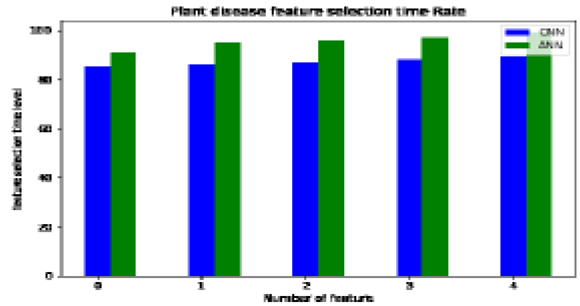


Fig 10: Feature selection Time level Testing CNN Model for Custom Input:

Fig 11: Prediction of Diseased cotton leaf

CONCLUSION

The training set may be embedded into IoT devices like Raspberry Pi and Arduino, connected to drones, and sent out into the fields; the CNN Model achieved better accuracy than the ANN Model. Creating a method for disease detection in cotton crop leaves is the primary objective of this research. The leaves of the cotton plant are the main entry points for diseases. The human eye is incapable of distinguishing between infinitely different cotton leaves, regardless of their color or texture. Consequently, a new approach to plant detection is necessary.

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JOURNAL OF CURRENT SCIENCE

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