Agriculture Resources for Plant-Leaf Disease Identification using Deep Learning Techniques

L K Hema¹*, D. Vijendra Babu², A. Navaneetharajan³, K. Vijayakumar⁴, S. Dhayanithi⁵

¹Professor & HOD, Department of Electronics and Communication Engineering, Aarupadai Veedu Institute of Technology, Vinayaka Mission's Research Foundation-Deemed to be University, Paiyanoor, Kancheepuram, TamilNadu, India
²Professor & Vice Principal, Department of Electronics and Communication Engineering, Aarupadai Veedu Institute of Technology, Vinayaka Mission's Research Foundation-Deemed to be University, Paiyanoor, Kancheepuram, TamilNadu, India
³, ⁴, ⁵UG Student, Professor, Department of Electronics and Communication Engineering, Aarupadai Veedu Institute of Technology, Vinayaka Mission's Research Foundation-Deemed to be University, Paiyanoor, Kancheepuram, TamilNadu, India

Email:*¹hemalk@avit.ac.in, ²vijendrababu@avit.ac.in

Abstract. Agriculture is an essential food supply. In developing countries like India, agriculture provides farmers with large-scale livelihood opportunities. The recent advances in computer vision brought on by in-depth learning have paved the way for detecting and diagnosing plant diseases by using a camera to take pictures. This study is an important means of distinguishing different diseases in various plant species. The system has been developed to detect and classify many plant varieties, including apples, wheat, grapes, potatoes, sugar cane and tomatoes. The computer is also able to diagnose a host of herbal diseases. The experts were able to create profound learning models that identified and differentiated plant diseases and non-attention of ailments with 25000 images of infected sound plant leaves and disease. The model produced was 95.3 percent accurate, and the gadget was able to report the accuracy up to 100 percent to classify and differentiate between the plant variety and the types of diseases that were infected by the plant.

Keywords: Agriculture, plants, accuracy, computer vision, camera.

1. Introduction

The Indian economy relies on productive agriculture. Agriculture accounts for over 70 per cent of rural households. Agriculture pays about 17 per cent of total GDP and provides more than 60 per cent of the population with jobs. Therefore plant disease identification plays a crucial role in the agricultural arena. Indian farming consists of many crops such as rice, wheat, etc. Also, it is growing sugar cane, oilseeds, potatoes and non-food products such as coffee, tea, cotton, rubber. All of these crops are grown based on leaf and root energy. For the plant leaves, there are issues that contribute to various diseases that spoiled crops and will eventually affect the country's economy. Specific forms of Disease in a plant destroy leaves.

Farmers are thinking that its harder to perceive these sicknesses as they can't play it safe on specific plants because of absence of data about these ailments. Biomedicine is one of the regions of plant ailment recognizable proof. The picture handling strategies are suitable, compelling and exact field for infection discovery with the help of plant leaf pictures in the current day right now. Ranchers need quick and
productive systems to recognize a wide range of plant ailments that can spare time. Early distinguishing proof of plant ailment assumes a noteworthy job in beneficial harvest yield. Plant illnesses, for example, dark measles, dark decay, bacterial spot, etc influence creation, plant crop quality, and financial effects in the agrarian business. Expensive techniques and the utilization of pesticides are a few procedures that ranchers regularly receive to forestall the impacts of these illnesses.

Chemical usage involves damage to both the plant and natural environment. Moreover, such a strategy intensifies farmers' output costs and significant monetary losses. The most important time for efficient control of disease is the early detection of diseases as they occur.

2. Literature Survey
Deep learning is progressively turning into the standard picture grouping system. This paper talks about the utilization of individual sores and spots for the undertaking, instead of thinking about the whole leaf. Since every territory has its own attributes, the information adaptability is improved without extra pictures being required. It likewise takes into consideration identifying a few infections that influence a similar leaf [1]. The Convolutional Neural Network is the premise of all models of significant learning. In this way a Convolutional Neural Network model is made and produced for the discovery and order of plant malady utilizing pictures of solid and ailing plants in the apple and tomato leaf [2]. Inside this paper, we set up an IOT-based checking framework for exactness cultivating applications, for example, the board of the pestilence infection. Such a rural checking framework offers natural observing administrations that protect the ideal status of the yield developing condition and early predicts the conditions that lead to the episode of plague ailment [3].

Plants are considered basic as they are the wellspring of vitality supply to mankind. Plant sicknesses can influence the leaf among planting and collecting whenever, bringing about colossal misfortunes in crop creation and market esteem [4]. Learning on move has been utilized to calibrate Alex Net. The certified CNN's application examination shows the amazing ability of oneself educated applications [5] [6]. Plant sickness diminishes the quality and amount of the rice crop. This paper proposes a technique for the recognizable proof of rice impact malady utilizing an AI calculation to group the illness at the beginning time of the collect [7]. Exact conclusion of rust from the wheat leaf is critical for exactness cultivating. Progressively, ghostly information were utilized to recognize this illness on leaf or covering scales; be that as it may, less consideration was paid to the leaf zone list (LAI) fluctuations [8]. We have seen that the utilization of information increment will expand model effectiveness. The model proposed was prepared utilizing distinctive preparing ages, bunch sizes, and dropouts [9]. The indications of plant illness are perceptible in different territories of a plant; yet leaves are viewed as the most usually watched segment for distinguishing a contamination. Researchers have along these lines endeavored to robotize the way toward distinguishing and ordering plant ailments utilizing photos starting from the earliest stage [10]. Analysis of plant illness is basic for developing and delivering crops. It tends to be practiced effectively by exploring master by optical perception of plant leaves, yet requires a high level of understanding and specialization [11]. The ID and examination of long non-protein-coding RNAs (lncRNAs) is pervasive in transcriptome contemplates in light of their job in organic procedures. LncRNA-protein cooperation specifically has conceivable importance for controlling quality articulation and for cell procedures, for example, plant pathogen opposition [12].

3. Implementation on Plant-Leaf Disease Segmentation
Deep Learning is a sort of Machine Learning (ML) that is an Artificial Intelligence (AI) branch that assumes a basic job in the improvement of understandable and self-ruling human frameworks. DL impersonates human cerebrum usefulness which comprises of tremendous quantities of neurons directed by a focal sensory system. Likewise, DL additionally comprises of numerous neural systems where every neuron is spoken to as a solitary hub and the whole procedure is overseen by the Central Processing Unit (CPU) or the Graphics Processing Unit (GPU) [13].
3.1. Pre-Processing:
Profound learning is the Artificial Intelligence and Machine Learning class that utilizes counterfeit neural systems. Preparing the profound learning models isolates the extraction of the usefulness and concentrates its arrangement highlights. There are numerous profound learning applications that incorporate PC vision, picture acknowledgment, recreation, voice, video examination, etc... Preprocessing data [14] is a method that prepares the raw data and makes it suitable for a machine learning model. This is the first and critical step toward building a model of machine learning. It's not always a case when we create a machine learning project that we come across the clean and formatted results. And when doing any data process, cleaning it up and putting it in a formatted manner is mandatory. And we use function of preprocessing data for this.

3.2. Features Extraction:
The extraction of features is a decrease of dimensionality by which an underlying assortment of crude information is diminished to increasingly reasonable gatherings for handling. A trait of these enormous informational collections is countless factors that take a great deal of computational assets to process [15]. Extraction of highlights is the term for techniques which select and join factors into highlights, adequately diminishing the measure of information to be prepared while still precisely and completely portraying the first assortment of information.

3.3. Convolution Layer:
Convolutionary layers store the portion yield from the past layer which comprises of loads and learning predispositions. The portions made which speak to the information without a mistake are the purpose of the enhancement work. A progression of numerical procedures is acted right now get the element guide of the picture information. It Exhibits the activity of a 5x5 picture input convolution layer, bringing about a 3x3 channel decreased to a littler measurement. The figure likewise shows the channel move beginning at the upper left corner of the info picture. The qualities are then duplicated by the channel esteems for each progression, and the additional qualities are the item has appeared in Figure1.

![Feature Extraction](image)

**Figure 1:** architecture diagram for plant leaf disease
3.4. Pooling Layer:
This layer takes out over fitting and the down inspecting layer diminishes the neuron scale. Furthermore, lessens the size of the element map, diminishes parameter numbers, train-time, calculation rate and over fitting controls. By accomplishing 100 percent on the preparation dataset and 50 percent on test information, over fitting is determined by a model. ReLU and max pooling were utilized to diminish the guide measurements of applications (GUI).

3.5. Activation Layer:
To use a non-linear activation layer of the ReLU (Rectified Linear Unit) in every layer of convolution is used to activate a pooling layer. Installation of dropout layers is also implemented in this layer to avoid over fitting.

3.6. Image Segmentation:
The picture information assortment used to prepare the model was procured in the store at Plant Village. Python content was utilized for downloading pictures from the storehouse of the plant ailments. The obtained dataset comprises of roughly 25,000 pictures, with plant assortments and sicknesses of 32 distinct gatherings. Pre-handled pictures are decreased to a given contribution with the picture size and the picture crop. It procedures and upgrades the image to the fitting size of shading. For preparing the investigation utilizes hued and resized pictures to goals of 96x96.

4. Result And Discussion
During the model testing, an accuracy rate of 95.3 per cent was achieved using 75 epochs. In analyzing random images of plant varieties and diseases, the model additionally accomplished a most extreme precision pace of 100 percent. The perception of train plots and the exactness of the test show that this model is suitable for the distinguishing proof and acknowledgment of plant ailments.

The dataset comprises of around 25,000 pictures containing nine unique sorts of tomato leaf illnesses, four distinct kinds of grape leaf maladies, four unique sorts of corn leaf sicknesses, four distinct kinds of apple leaf ailments and six distinct sorts of sugarcane ailments. For the CNN model execution, a neural system usage program interface (API), written in Python, was utilized. The whole picture dataset has been utilized for preparing and research, utilizing 1,000 pictures taken from the field. All through the application, information expansion systems were executed to improve the picture dataset by pivoting the pictures to 25 degrees, flipping and moving pictures on a level plane and vertically. Utilizing an absolute cross-entropy, Adam analyzer is coordinated. The model utilized a cluster size of 32, instructed 75 ages. All the investigations were performed on Dell Inspiron 14-3476 i5 processor and 16GB memory limit. All the last groupings are appeared in the Figure 2. With a CNN-based calculation, we performed grouping process utilizing photographs of apple and tomato leaves-unhealthy and stable from Plant Village dataset. All pictures that are entered are resized to 64x64. This resized picture is taken care of to the convolution layer to acquire the yield as 62x62, utilizing the conditions (2) and (3) and to make sense of the yield width and yield tallness (64-3 + 0)/1 + 1=62, where 64 is the picture size of the presentation, 3 is the channel width (for example 3x3) utilized, 0 is the cushioning number with a 1.
5. Conclusion

Peoples around the globe are subject to the rural area as one of the most significant segments in which yields are the basic nourishment need. For the horticultural business, early distinguishing proof and recognition of these infections is basic. This paper has accomplished its objective of recognizing and distinguishing 32 unique assortments of plants and plant sicknesses utilizing a convolutional neural system. The prepared model can be utilized to check pictures continuously for the recognizable proof and acknowledgment of plant ailments. Extra plant assortments and various sorts of plant sicknesses can be remembered for the ebb and flow dataset to improve the certified models for future research. Numerous CNN designs can likewise utilize differing learning levels and streamlining agents to explore different avenues regarding model proficiency and precision. The proposed model will empower ranchers to recognize and distinguish plant infections with the precision of 95.3 percent accomplished.

References

[1] Bhagat, M., Kumar, D., Haque, I., Munda, H.S. and Bhagat, R., 2020, February. Plant Leaf Disease Use Grid Search Based SVM Classification. In 2nd International Conference on Data, Engineering and Applications (IDEA) (pp. 1-6). IEEE.

[2] Reddy, J.N., Vinod, K. and AS, R.A., 2019, February. Farm Leaf Disease Detection Recognition Algorithms. In 2019 IEEE International Conference on Electrical, Computer and Communication Technologies (ICECCT) (pp. 1-6). IEEE.

[3] Kumar, D.A., Chakravarthi, P.S. and Babu, K.S., 2020, August. Color, texture and shape identification characteristics multi class support vector Machine based plant leaf conditions. In 2020 Third International Conference on Smart Systems and Inventive Technology (ICSSIT) (pp. 1220-1226). IEEE.

[4] Chouhan, S.S., Kaul, A. and Singh, U.P., 2019, November. Neural radial base function network for plant leaf disease segmentation. In 2019 4th International Conference on Information Systems and Computer Networks (ISCON) (pp. 713-716). IEEE.
[5] Nalawade, R., Nagap, A., Jindam, L. and Ugale, M., 2020, April. Field surveillance and the
detection of diseases in plant leaves. In 2020 3rd International Conference on Communication
System, Computing and IT Applications (CSCITA) (pp. 226-231). IEEE.

[6] Rahman, M.A., Islam, M.M., Mahdee, G.S. and Kabir, M.W.U., 2019, May. Enhanced approach to
plant disease identification segmentation. In 2019 1st International Conference on Advances in
Science, Engineering and Robotics Technology (ICASERT) (pp. 1-5). IEEE.

[7] Trivedi, J., Shammari, Y. and Gajjar, R., 2020, February. Machine Learning Plant Leaf Disease
Identification. In International Conference on Emerging Technology Trends in Electronics
Communication and Networking (pp. 267-276). Springer, Singapore.

[8] Trang, K., TonThat, L. and Thao, N.G.M., 2020, June. Deep Convolutionary Autoencoder as a
Feature Method Recognition of Plant Leaf Disease. In 2020 17th International Conference on
Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology
(ECTI-CON) (pp. 522-526). IEEE.

[9] Geetharamani, G. and Pandian, A., 2019. Identification of plant-leaf diseases through a deep neural
network of 9 layers. Computers & Electrical Engineering, 76, pp.323-338.

[10] Gobalakrishnan, N., Pradeep, K., Raman, C.J., Ali, L.J. and Gopinath, M.P., 2020, July. A
systematic assessment of image recognition and machine learning methods for plant disease
detection. In 2020 International Conference on Communication and Signal Processing (ICCSP) (pp.
0465-0468). IEEE.

[11] Kumar, V., Arora, H. and Sisodia, J., 2020, July. ResNet-based approach to plant leaf disease
identification and classification. In 2020 International Conference on Electronics and Sustainable
Communication Systems (ICESC) (pp. 495-502). IEEE.

[12] Leong, K.K. and Tze, L.L., 2020, June. Identification of plant leaf diseases through the
Convolutionary Care Network. In 2020 IEEE International Conference on Automatic Control and
Intelligent Systems (ICACIS) (pp. 39-44). IEEE.

[13] J., Lv, F. and Di, P., 2019, December. Random Forest Algorithm Recognition of Sunflower Leaf
Diseases. In 2019 International Conference on Intelligent Computing, Automation and Systems
(ICICAS) (pp. 459-463). IEEE.

[14] Jogekar, R. and Tiwari, N., 2020, July. Leaf-based system system for the identification of plant
disease: A compilation of systematic study findings to classify the leaf disease classification
schemes. In 2020 Fourth World Conference on Smart Trends in Systems, Security and
Sustainability (WorldS4) (pp. 745-750). IEEE.

[15] Iqbal, M.A. and Talukder, K.H., 2020, August. Picture segmentation and machine learning
Identification of Potato Disease. In 2020 International Conference on Wireless Communications
Signal Processing and Networking (WiSPNET) (pp. 43-47). IEEE.