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AUTOMATIC LEAF DISEASES DETECTION SYSTEM USING CNN

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Abstract: Plant diseases have a major influence on crop productivity and quality, despite agriculture's critical role in ensuring global food security. Conventional illness detection techniques take a lot of time and call for professional assistance. This research proposes a Convolutional Neural Network (CNN) based Automatic Leaf Disease Detection System to overcome these difficulties. The technology effectively classifies and diagnoses a variety of plant illnesses by processing photos of leaves. Using deep learning methods for feature extraction and classification, the suggested model is trained on a varied dataset of both healthy and diseased leaves. High accuracy in identifying illnesses like bacterial infections, fungal infections, and nutritional deficits is guaranteed by the CNN architecture. The technology is intended to help farmers and agricultural specialists discover diseases early, minimizing crop losses and enhancing the quality of yields. The suggested method is a useful tool for smart farming applications since experimental results show how well it works for real-time disease identification.

***Index Terms* – Deep Learning, CNN, Plant Disease Detection, Image Processing and Leaf image Classification.**

I.INTRODUCTION

The foundation of the world economy is agriculture, which supplies food and raw materials for a variety of businesses. Plant diseases, on the other hand, are a serious danger to agricultural productivity since they lower crop yields and cause farmers to lose money. For efficient disease control and better agricultural results, early and precise plant disease diagnosis is essential. Conventional disease detection techniques depend on expert manual inspection, which is laborious, arbitrary, and frequently out of reach for small-scale farmers as deep learning and artificial intelligence (AI) have advanced, automated disease detection systems have become increasingly potent instruments for precision farming. Deep learning models known as Convolutional Neural Networks (CNNs) have demonstrated exceptional performance in image-based classification tasks, which makes them ideal for identifying plant illnesses from photos of leaves. An Automatic Leaf Disease Detection System can identify illnesses with high accuracy, analyze photos of diseased leaves, and give farmers timely advice by utilizing CNNs. In order to overcome the shortcomings of conventional disease identification techniques, this research proposes an automated leaf disease detection system that makes use of CNNs. A dataset of both healthy and diseased leaves is used to train the suggested system, which then extracts pertinent characteristics to distinguish between different plant illnesses. By incorporating this technology into farming operations, crop health and productivity can be improved, early disease detection can be aided, and reliance on professional intervention can be decreased.

II. LITERATURE REVIEW

[1] AI-Bashish et al. (2011) developed a system for detecting and classifying leaf diseases using image processing and neural networks They used K-means clustering to segment the diseased parts of the leaf based on colour differences. After segmentation, a neural network was used to classify the type of disease their method showed good results and was one of the early works to combine basic image processing with machine learning for plant disease detection. However, the system required manual feature extraction and was less effective with complex images or varying backgrounds. This study helped open the door for more advanced approaches, like deep learning, which can automatically learn features from images.

[2] Sharada P. Mohanty et al. (2016) worked on using deep learning to detect plant diseases from images They trained a Convolutional Neural Network (CNN) on a large dataset of plant leaf images with different diseases. The model could automatically learn features from the images and classify them with high accuracy. Their system was able to identify 26 different diseases across 14 crop species, showing that deep learning is a powerful tool for plant disease detection. This study proved that CNNs can perform better than traditional machine learning methods that rely on manual feature extraction.

[3] Neethu K.S and P. Vijay Ganesh (2017) proposed a system to detect leaf diseases and suggest suitable pesticides using an Artificial Neural Network (ANN), Their method involved processing the image to extract features like colour and texture, which were then given to the ANN for classification of the disease. After identifying the disease, the system also recommended a suitable pesticide to treat it, making it useful for farmers. Although effective, the system relied on manual feature extraction and was limited to specific types of diseases.

[4] Shima Ramesh et al. (2018) presented a system for plant disease detection using machine learning techniques, they used image processing to extract features from plant leaf images and then applied machine learning algorithms to classify the diseases. The study focused on improving the accuracy of detection and making the system more helpful for farmers. Although it did not use deep learning, the research showed that machine learning can still be effective for disease identification if the features are selected properly.

[5] Ashish Nage and V.R. Raut (2019) developed a system for detection and identification of plant leaf diseases using Python-based tools. Their method involved processing images of leaves to detect affected areas and then using machine learning techniques for classification. the study focused on using Python libraries such as OpenCV for image processing and applied classification algorithms to recognize different types of diseases. The system was designed to be simple, efficient, and useful for real-time applications.

[6] G. Geetha et al. (2020) proposed a system for plant leaf disease classification and detection using machine learning techniques, The system used image processing to extract important features from leaf images, such as colour, shape, and texture. These features were then used to train machine learning models for identifying and classifying different plant diseases. their approach focused on improving accuracy and making the system more efficient for real-time use. The study demonstrated that machine learning can be a valuable tool in agriculture, especially when combined with proper image preprocessing.

[7] Pandian et al. (2022) proposed a deep learning model with five convolutional layers for the detection of plant leaf diseases. Their model is based on a Deep Convolutional Neural Network (DCNN), designed to automatically extract complex features from leaf images and classify them into different disease categories. The study showed that using multiple convolutional layers improves the accuracy and performance of the detection system. The model was tested on a variety of leaf images and achieved high precision in identifying disease types.

[8] S. Arivazhagan et al. (2013) developed a method for detecting unhealthy regions in plant leaves and classifying plant diseases using texture features. Their approach involved segmenting the affected areas of the leaf and extracting features such as texture and colour, which were then used for disease classification. the study showed that texture-based features can be effective in identifying different types of leaf diseases. However, the method relied on manual feature extraction and traditional classifiers, which may not perform well on large or complex datasets compared to deep learning methods.

III. EXISTING SYSTEM

Efficient Net and U-Net, two potent deep learning models, are integrated into the present system for autonomous plant leaf disease diagnosis. A family of convolutional neural networks called EfficientNet is renowned for optimizing model scaling to achieve high accuracy with fewer parameters. Using features taken from input photos, Efficient Net is used in this system to categorize various leaf diseases. In addition, U-Net functions as the segmentation model, separating the leaf's sick areas for closer examination. Because of its encoder-decoder design, U-Net is ideally suited for pixel-level predictions. This enables the model to provide segmentation masks that effectively differentiate between healthy and infected regions. The system can precisely locate and detect the presence of disease thanks to the integration of these models. Image preprocessing is the first step in the process, which is then followed by segmentation, feature extraction, and classification. In benchmarks and experimental configurations, this deep learning pipeline has demonstrated encouraging outcomes, including precise identification of a wide range of plant diseases. Although the approach works quite well in controlled settings, its effectiveness may suffer in real-world situations where there is noise, fluctuating lighting, or diverse plant species. Its scalability in agricultural settings with low-cost equipment is further limited by its dependence on high-quality photos and computational resources. Additionally, the model might need to be adjusted or retrained for novel diseases, which lengthens the time and complexity of development.

IV. PROPOSED SYSTEM

Plant diseases are more prevalent in the agricultural sector, and for the reasons mentioned above, it is now easier to identify plant diseases. Detecting plant diseases has become more important in monitoring crops in wide and diverse areas these days. Farmers deal with a lot of difficulties when switching from one disease management strategy to another. The conventional method for detection is to identify or recognize the leaf diseases for surveillance and monitoring specialists. If the right measures aren't performed, the plants suffer severe consequences, which will have an impact on the quality of the trousers and the plants' output. Because it reduces the excessive labor required for surveillance in vast cultivations, disease detection using some automated technology and methodology is effective and beneficial. identification of plant diseases. We employed four deep learning models—the CNN, efficient net, and unet models—for the categorization. including recommendations for medications.

4.1 Block Diagram

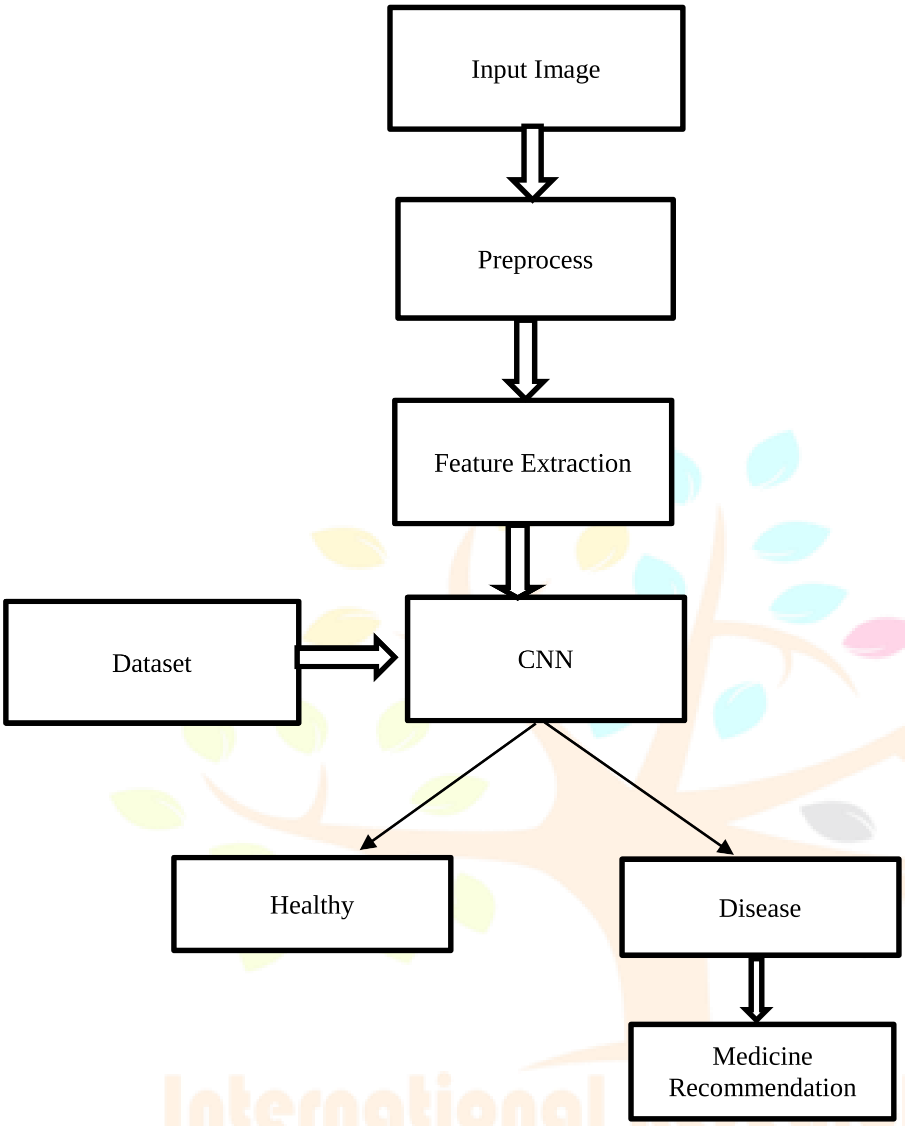

Fig No 1: Block Diagram

4.2 Working Algorithm

4.2.1 Input Image (Plant Leaf): The process begins with capturing or uploading an image of a plant leaf. This image serves as the primary input for the system, and its visual characteristics—such as color, texture, and structure—are crucial for identifying whether the plant is healthy or affected by a disease. The image can be taken from various sources like a smartphone camera, agricultural monitoring drones, or image databases. It acts as the first step toward diagnosing the plant's condition.

4.2.2 Preprocessing: Once the image is acquired, it undergoes preprocessing to enhance its quality and ensure uniformity for analysis. Preprocessing typically includes resizing the image to a fixed dimension, removing noise using filters like Gaussian blur, and adjusting contrast to make important features more prominent. Additionally, the leaf may be segmented from the background so that the analysis focuses only on relevant parts of the image. This step is essential for reducing computational complexity and increasing the effectiveness of the later stages in the pipeline.

4.2.3 Feature Extraction: Following preprocessing, feature extraction is carried out to convert the cleaned image into a set of measurable characteristics that represent important visual properties. These features may include color distribution, edge patterns, texture irregularities, and shape deviations. Though CNNs inherently perform automatic feature extraction, this step highlights how the system breaks down the visual content into meaningful data. These extracted features are critical for enabling the model to distinguish between healthy and diseased leaves effectively.

4.2.4 CNN (Convolutional Neural Network): The extracted features are then fed into a Convolutional Neural Network (CNN), a deep learning model specifically designed for analyzing visual data. The CNN is trained using a large dataset of labeled plant images, which includes both healthy leaves and leaves affected by various diseases. The CNN processes the input through multiple layers such as convolutional, pooling, and fully connected layers to learn hierarchical representations of the input features. Based on this learning, the CNN classifies the image into predefined categories with high accuracy.

4.2.5 Classification: After analyzing the image, the CNN outputs a classification result. The image is categorized either as "healthy" or as showing signs of a specific disease. This classification is based on the visual patterns learned during training and validated against a test dataset. If the image is determined to be healthy, the process concludes there. However, if the image shows disease symptoms, it is flagged for further action, prompting the system to proceed to the next step generating treatment suggestions.

4.2.6 Medical Recommendation: When a disease is detected, the system provides a tailored medical recommendation to address the specific issue. This could involve suggesting chemical treatments such as fungicides or insecticides, or organic alternatives like neem oil or compost-based remedies. The recommendation is based on the identified disease and its known cures, and may include dosage guidelines, application frequency, and additional farming tips. This step not only helps farmers and gardeners respond quickly but also supports sustainable and effective crop management.

V. RESULTS

The outputs of an automatic leaf disease detection system using CNN (Convolutional Neural Networks) for healthy and diseased.

Fig No 2: Input Image

Fig No 3: Output Image

Fig No 4: Input Image

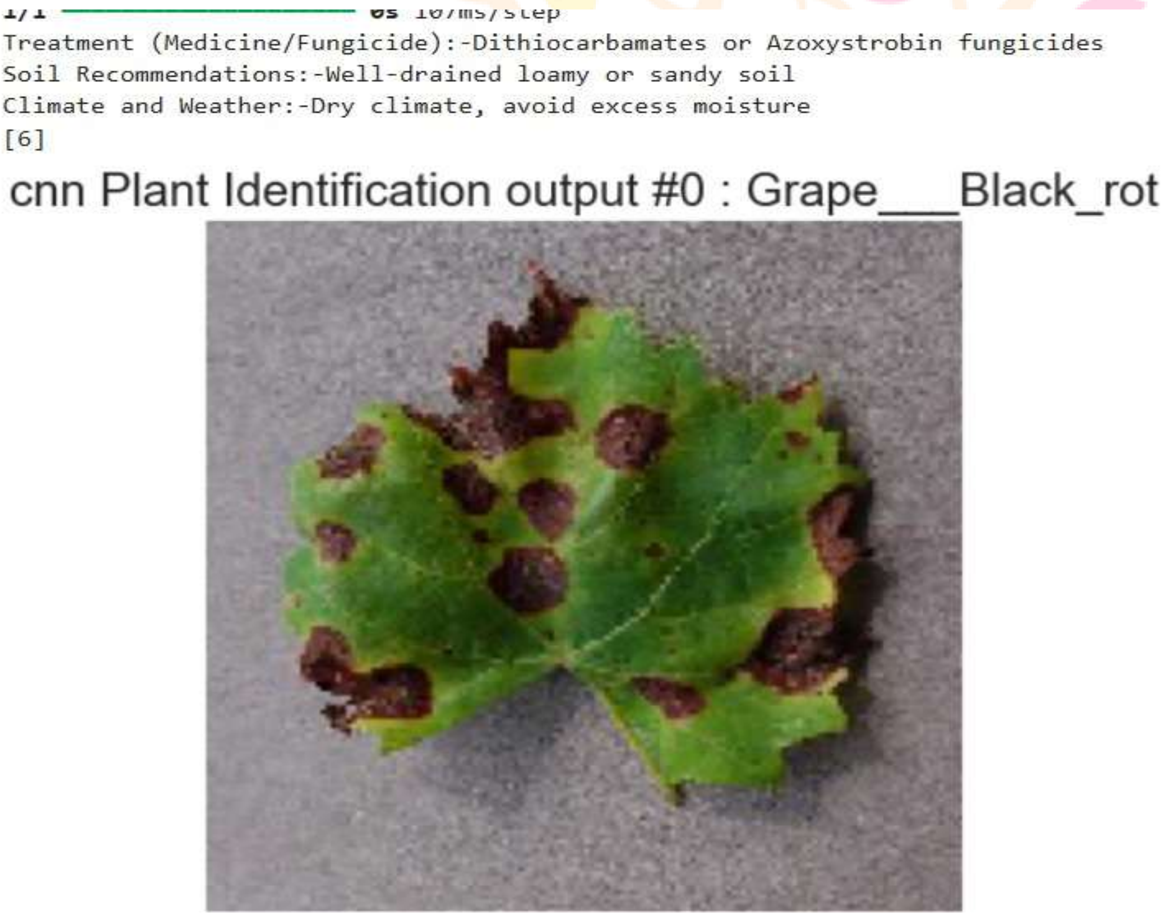

Fig No 5: Output Image

VI. CONCLUSION

The study successfully demonstrates an efficient approach for automatic detection and classification of various plant leaf diseases using image processing and machine learning techniques. By focusing on different species such as banana, tomato, potato, grape, mango, and soybean, the proposed method has shown high accuracy and adaptability with minimal computational efforts. The ability to identify leaf diseases at an early stage enhances the effectiveness of disease management and contributes to yield improvement, particularly in developing countries like India. The integration of parameters like DSI, IPR, and DLP further improves the prediction and grading of infection levels. The system's accessibility through mobile cameras and its automatic operation makes it practical for real-world agricultural applications without the need for sophisticated tools.

VII. FUTURE SCOPE

Future developments in this field can focus on enhancing the accuracy and scalability of the system by incorporating deep neural networks and larger, more diverse datasets. Implementing advanced CNN and DNN models can improve infection severity grading and enable remote diagnosis more effectively. There is potential to integrate the system with IoT devices for real-time monitoring and alerts in farms, parks, and forest areas. Furthermore, the automation of disease-infected leaf removal using robotic hardware could be explored. Extending this research to detect plant diseases in forest ecosystems and integrating GPS-based mapping could contribute significantly to biodiversity conservation and environmental monitoring. The fusion of this technology with cloud platforms and mobile applications would ensure broader accessibility and real-time support for farmers and agronomists globally

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REFERENCES

[1] Robert G. de Luna, Elmer P. Dadios, Argel A. Bandala, "Automated Image Capturing System for Deep Learning-based Tomato Plant Leaf Disease Detection and Recognition," International Conference on Advances in Big Data, Computing and Data Communication Systems (icABCD) 2019.

[2] Suma VR Among Shetty, Rishab F Tated, Sunku Rohan, Triveni S Pujar, "CNN based Leaf Disease Identification and Remedy Recommendation System," IEEE conference paper 2019

[3] Peng Jiang, Yuehan Chen, Bin Liu, Dongjian He, Chunquan Liang, "Real-Time Detection of Apple Leaf Diseases Using Deep Learning Approach Based on Improved Convolution Neural Networks," IEEE ACCESS 2019

[4] Geetharamani, Arun Pandian, "Identification of plant leaf diseases using a nine- layer deep convolution neural network," Computers and Electrical Engineering 76 (2019).

[5] Robert G. de Luna, Elmer P. Dadios, Argel A. Bandala, "Automated Image Capturing System for Deep Learning-based Tomato Plant Leaf Disease Detection and Recognition," Proceedings of TENCON 2018 - 2018 IEEE Region 10 Conference

[6] Omkar Kulkarni, "Crop Disease Detection Using Deep Learning," IEEE access 2018

[7] Abirami Devaraj, Karunya Rathan, Sarvepalli Jaahnavi and K Indira, "Identification of Plant Disease using Image Processing Technique," International Conference on Communication and Signal Processing, IEEE 2019

[8] Balakrishna K Mahesh Rao, "Tomato Plant Leaves Disease Classification Using KNN and PNN," International Journal of Computer Vision and Image Processing 2019.

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