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LEAF DISEASE DETECTION USING MACHINE LEARNING

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Abstract: Leaf disease detection is an important task in crop management and can be done with the help ofConvolutional Neural Networks (CNNs). CNNs are a type of artificial neural network designed specifically for image recognition tasks such as detecting patterns in images. In this paper, we propose a CNN-based method for plant disease detection which uses an available dataset to extractfeatures from an image of a plant and then classifies it into one or more disease classes. We also found that our model was able to accurately identify subtle differences between diseased plants compared to healthy ones - something traditional methods were not capable of doing on their own. The proposed method can be used for real-time use in crop management as it helps reduce crop loss and increase yields by detecting diseases early before they spread further.

Index Terms **– Leaf disease Detection, Crop Management, CNN, Image Recognition**

I. INTRODUCTION

An Enhanced Leaf Disease Detection Framework Using Machine Learning is a machine learning-based system that is designed to identify various types of leaf diseases in crops accurately and efficiently. The system uses the Convolutional Neural Network-LeNet architecture to classify thediseases based on the input data, which is images of leaves that have been affected by diseases.

The system has the potential to benefit the agriculture industry significantly by improving diseasedetection and prevention, leading to improved crop yields and reduced losses. The system is designed to be user-friendly and accessible to farmers and other end-users, allowing them to quickly and easily identify diseases in their crops.

The system can be used in various settings, including farms, nurseries, and greenhouses. It can beintegrated with existing agricultural technologies and systems, such as drones and sensors, to provide a comprehensive solution for disease detection and prevention.

The system's scope includes the development of a machine learning model, a user-friendly interface, and integration with existing agricultural technologies. The system's development will require significant investment in terms of technology, training, and maintenance. Additionally, compliance with data privacy and protection regulations must be ensured.

In conclusion, an enhanced leaf disease detection system using the CNN-LeNet approach is a promising solution for improving disease detection and prevention in the agriculture industry. Thesystem's development requires careful consideration of various feasibility aspects and a comprehensive understanding of the system's scope and potential benefits.

II. LITERATUR SURVEY

1.Al Bashish, M. Braik, and S. Bani-Ahmed (2010)

This study presents a framework for detecting and classifying plant leaf and stem diseases using image processing techniques. The authors developed a system that integrates image processing algorithms for feature extraction and classification methods for disease identification.

2. Camargo, A. and J. S. Smith (2009)

Camargo and Smith explored image pattern classification for identifying disease-causing agents in plants. Their work focused on developing classification models that utilize image patterns to differentiate between healthy and diseased plant parts.

3. H Sabrol and K Satish (2016)

In their research, Sabrol and Satish used classification trees to classify tomato plant diseases based on digital images. The study underscored the potential of classification trees in creating a straightforward yet effective disease classification system.

4. Umair Ayub and Syed Atif Moqurrab (2018)

Ayub and Moqurrab applied data mining teniques to predict crop diseases. Their approach illustrated how data mining can be leveraged to enhance disease prediction and management in agriculture.

5. Surampalli Ashok and Gemini Kishor (2020)

Ashok and Kishor focused on tomato leaf disease detection using deep learning techniques. This study highlighted the power of deep learning models in handling complex image data and improving disease detection capabilities.

6. Sumit Nema (2018)

Nema's work centered on wheat leaf detection and prevention using support vector machines (SVMs. The study illustrated the potential of SVMs in agricultural disease management, offering a robust approach to leaf disease classification.

7. Sandeep Kumar and KMVV Prasad (2020)

Kumar and Prasad proposed a machine learning-based approach for leaf disease detection and classification. The study demonstrated the effectiveness of machine learning in improving the accuracy and efficiency of disease detection.

8. Muhammad and Shoaib (2020)

Shoaib's study focused on deep learning-based segmentation and classification of leaf images for tomato plant disease detection. By employing advanced deep learning methods, Shoaib achieved high precision in

segmenting and classifying diseased and healthy parts of tomato leaves, showcasing the potential of deep learning in plant disease management.

9. Abdulridha et al. (2020)

This study by Abdulridha and colleagues explored hyperspectral imaging techniques for detecting target spot and bacterial spot diseases in tomatoes. The research highlighted the advantages of hyperspectral imaging in providing comprehensive disease diagnostics**.**

10. Agarwal et al. (2020)

Agarwal and team developed ToLeD, a system for tomato leaf disease detection using convolutional neural networks (CNNs). The study emphasized the capabilities of deep learning techniques in enhancing disease detection systems.

11.Md. Tariqul Islam (2020)

Islam's study focuses on using Convolutional Neural Networks (CNNs) combined with image processing techniques for plant disease detection. The study underscores CNNs' capability to enhance disease detection by leveraging advanced image processing techniques.

III. SYSTEM ANALYSIS AND DESIGN

The field of agriculture is one of the most critical areas of research and development that contributes to the world's food security. However, the increase in demand for food production poses a significant challenge to the farmers and plant experts to address plant diseases that can potentially harm crops' growth and yield. Leaf disease detection is one of the critical componentsin agriculture that can help farmers and plant experts diagnose the diseases and take appropriate action to prevent or reduce the damage. Machine learning techniques have emerged as a powerfultool for plant disease detection, providing accurate and efficient results.

The enhanced leaf disease detection framework is a machine learning-based system that aims to detect and diagnose leaf diseases from digital images. The framework is composed of several steps,starting with image acquisition and preprocessing. Image acquisition involves capturing the digitalimages of the plant leaves using a camera or a smartphone. Preprocessing involves enhancing theimage quality by reducing noise, adjusting contrast, and removing unwanted elements from the image.

Once the preprocessed images are obtained, the next step is feature extraction. Feature extractionis the process of selecting the most relevant features from the image to use in the classification process. Several feature extraction techniques, such as Gabor filter, wavelet transform, and textureanalysis, can be used to extract the features.

The next step is the classification process, where the extracted features are used to classify the plant leaves into healthy or diseased. The classification process involves training a machine learning model using a set of labeled images. The model learns the features of the images and thecorresponding label and can classify the images into their respective categories. Several machine learning algorithms, such as Support Vector Machine (SVM), Random Forest, and ConvolutionalNeural Networks (CNNs), can be used for classification.

The final step in the enhanced leaf disease detection framework is the decision-making process, where the classified images are analyzed to determine the severity of the disease and theappropriate action to take. The decision-making process can be done manually by experts or automatically using machine learning algorithms

In conclusion, the enhanced leaf disease detection framework is a powerful tool for plant disease detection, providing accurate and efficient results. The framework can be used by farmers and plant experts to detect and diagnose leaf diseases early, preventing or reducing the damage to crops. The use of machine learning algorithms in the framework ensures that the system can continuously learn and improve its accuracy.

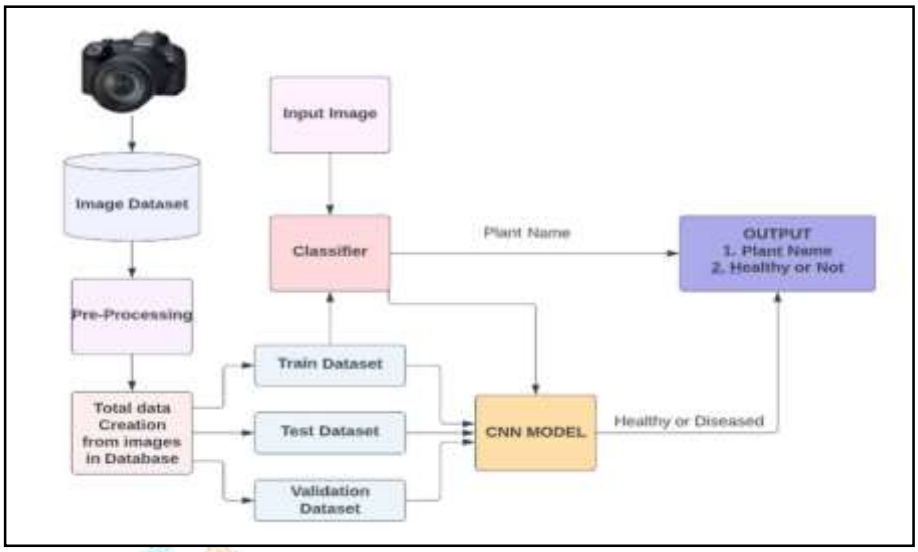

Figure 1. System Architecture

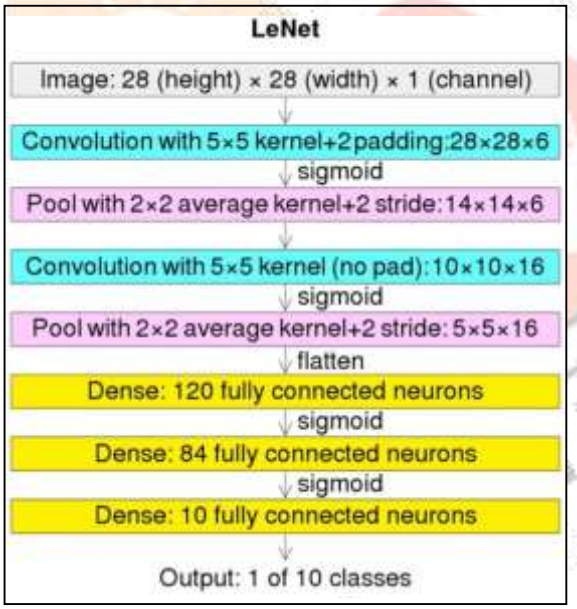

Figure 2 LeNet Architecture

I. IMPLEMENTATION

LeNet-5:

LeNet-5 is a convolutional neural network (CNN) architecture that was developed by Yann LeCun, Leon Bottou, Yoshua Bengio, and Patrick Haffner in 1998. It was one of the first successful convolutional neural networks and was designed specifically for handwritten digit recognition. TheLeNet-5 architecture consists of seven layers: two convolutional layers, two subsampling layers, and three fully connected layers. The first convolutional layer uses 6 filters of size 5x5, and the second convolutional layer uses 16 filters of size 5x5. The subsampling layers use average poolingwith a 2x2 filter size. The fully connected layers have 120, 84, and 10 nodes, respectively, with the last layer being a softmax output layer for classification. The LeNet-5

algorithm has been widely used for digit recognition tasks and has achieved high accuracy rates. It has also served asa foundation for many modern

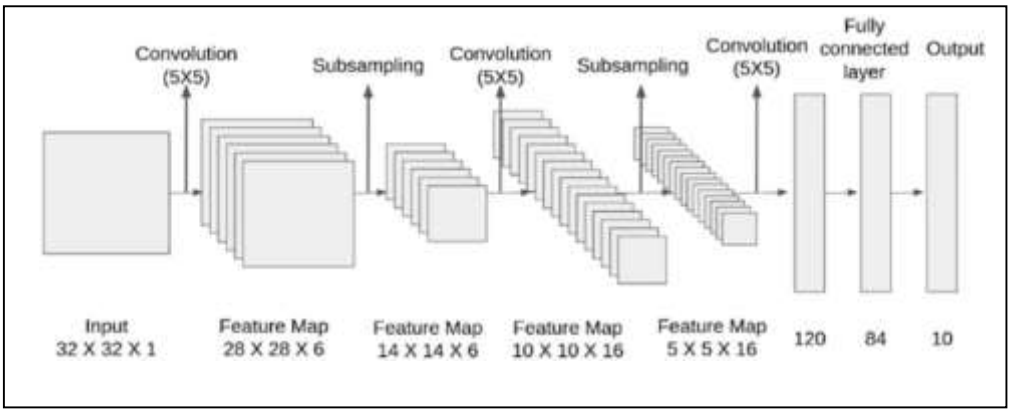

Figure 3: LeNet-5 Architecture

CNN architectures, such as AlexNet and Google Net, and has pavedthe way for the current state-of-the-art deep learning models. Overall, LeNet-5 is a simple yet effective architecture that helped to demonstrate the power of convolutional neural networks for image recognition tasks.

LeNet-5 achieved state-of-the-art performance on handwritten digit recognition tasks, surpassing previous methods such as Support Vector Machines (SVMs) and Multi-Layer Perceptrons (MLPs).On the MNIST dataset, which consists of 60,000 training and 10,000 testing grayscale images of size 28x28, LeNet-5 achieved a test error rate of 0.95%, which was a significant improvement overprevious method. Since then, LeNet-5 has been used as a benchmark for many other image recognition tasks and has served as a foundation for many modern CNN architectures.

IV. RESULT AND ANALYSIS

Detection of LeNet-5 Model:

Tomato images results

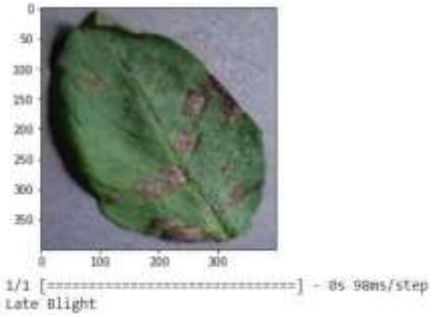

Figure 4: Model Detected Tomato Late Blight

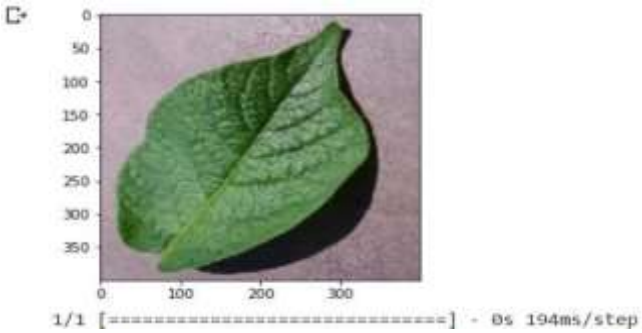

Figure: Model Detected Tomato Healthy

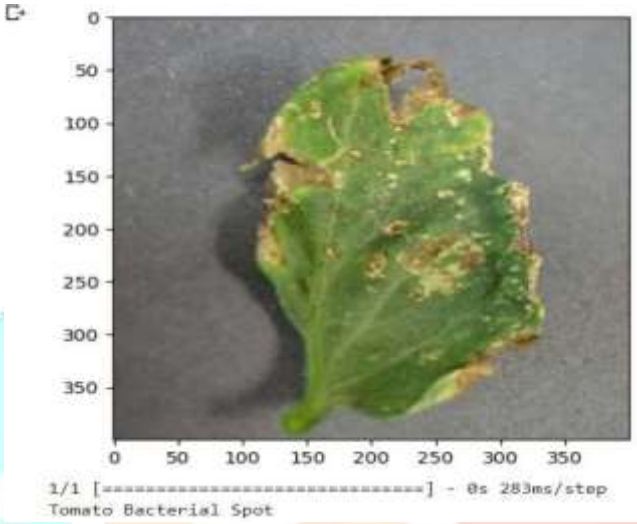

Figure 6: Model Detected Tomato Bacterial Spot

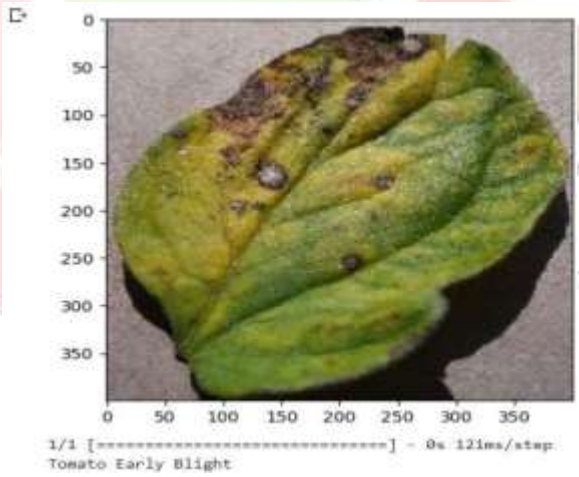

Figure 7: Model Detected Tomato Early Blight

I. CONCLUSION

The "An Enhanced Leaf Disease Detection Framework Using Machine Learning" is a research paper that presents a novel approach to detecting plant diseases using machine learning algorithms.The proposed framework is based on image processing techniques and machine learning algorithms such as Support Vector Machine (SVM) and Convolutional Neural Network (CNN).

The proposed framework has several advantages over the existing methods. First, it is highly accurate in detecting different types of plant diseases. Second, it is computationally efficient and can be used in real-

time applications. Third, it can be easily integrated with other systems to builda complete plant disease monitoring and management system.

In conclusion, the "An Enhanced Leaf Disease Detection Framework Using Machine Learning" paper presents a highly accurate and efficient approach to detect plant diseases using machine learning algorithms. The proposed framework can be a valuable tool for farmers and researchers to monitor plant health and prevent crop loss due to diseases.

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