e-ISSN:2582-7219

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

Volume 7, Issue 4, April 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.521

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly Peer Reviewed & Referred Journal |

| Volume 7, Issue 4, April 2024 |

| DOI:10.15680/IJMRSET.2024.0704139 |

Leaf Disease Detection

Ms. D. R. Kamble[1], Ms. Snehal Krishna Gadale[2], Ms. Dhanashri Nitin Pawar[3], Ms. Gauri Dhanaji Shedage[4], Ms. Mukti Mahajan[5]

Department of Computer Science and Engineering, AGTI's Dr. Daulatrao Aher College of Engineering, Karad, Maharashtra, India

ABSTRACT: The agricultural sector plays a crucial role in sustaining the world's growing population. However, the prevalence of plant leaf diseases can significantly impact crop yields and quality. This project leverages the power of deep learning techniques to develop an automated system for the early detection of plant leaf diseases. By utilizing a large dataset of annotated leaf images and state-of-the-art convolutional neural networks (CNNs), this research aims to accurately identify and classify various plant leaf diseases, including but not limited to fungal, bacterial, and viral infections. In this project, we propose an innovative approach to tackle this issue. Specifically, we utilize convolutional neural networks (CNNs) to analyze images of plant leaves and classify them into healthy or diseased categories. To ensure the robustness of our model, we curate an extensive dataset comprising images of various plant diseases and healthy leaves. This project stands to benefit the agriculture industry by offering a cost-effective, scalable, and timely solution for plant disease detection.

KEYWORDS: Leaf Disease Detection, Deep Learning, Leaf Disease Classification, Convolutional Neural Network (CNN)

I. INTRODUCTION

The health and productivity of agricultural crops are vital for ensuring global food security and sustainable development. However, the prevalence of plant diseases poses significant threats to crop yields, leading to substantial economic losses for farmers worldwide. Detecting plant diseases in a timely and accurate manner is crucial for effective disease management and minimizing crop damage. Therefore, this project aims to contribute to the field of plant pathology by developing a "Leaf Disease Detection" system capable of efficiently identifying diseases affecting various crops. Manual disease identification in agriculture is a prevalent practice, where farmers rely on their experience or consult scientists to correlate disease patterns on leaves. However, this approach is not foolproof, and accurate predictions are often challenging, leading to a trial-and-error process. Early disease identification is crucial for maximizing crop yield.

Fortunately, with the progress in deep learning and computer vision technologies, automatic disease detection using plant leaf images has become feasible. Machine learning, particularly Deep Learning, utilizes Artificial Neural Networks to mimic the human brain's neural network. Convolutional Neural Networks (CNNs), a type of deep learning system, can automatically identify patterns in image data by discerning rules and storing them as weights and biases for future predictions.

II. LITERATURE REVIEW

The proposed paper by Ebrahim Hirani [1] aims to explore the application of deep learning techniques, specifically Convolutional Neural Networks (CNNs), in plant disease detection. It acknowledges the significance of CNNs in various computer vision tasks, including image classification, feature extraction, and segmentation, and highlights the importance of addressing plant diseases due to their detrimental effects on agricultural yield. While CNNs have been extensively used in plant disease detection, the paper discusses limitations associated with these approaches. It then introduces transformer networks as a promising alternative, citing their recent successes in computer vision tasks. Transformer networks have gained attention for their ability to capture long-range dependencies in data, which can be beneficial in image analysis tasks.

The primary objective of the paper is to compare the performance of transformer networks with traditional CNN approaches in the context of plant disease detection. It likely presents a review of different methods used for

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identifying plant leaf diseases, covering both traditional image processing techniques followed by machine learning models and newer deep learning architectures. By comparing these approaches, the paper aims to provide insights into the effectiveness of transformer networks compared to CNNs in addressing the challenges of plant disease detection. This comparison can help researchers and practitioners understand the strengths and limitations of each approach and guide future developments in this field.

Ansari Fatima Aness [2] developed a Leaf Disease Detection system aimed at enhancing crop productivity by promptly identifying and preventing crop diseases. The study utilized deep convolutional neural network (CNN) models, specifically VGG16 and VGG19 architectures, to identify and diagnose diseases in corn plants based on images of their leaves. The dataset comprised 3000 colored corn leaf photos, including both healthy and diseased leaves. The study compared the performance of VGG16 and VGG19 architectures and found that both models outperformed conventional feature-based methods in terms of disease classification accuracy. Specifically, the accuracy rates achieved were 94.1% for VGG16 and 96.5% for VGG19. Additionally, the models required less training time compared to previous deep learning models. The promising outcomes suggest that the deep CNN model significantly influences the effective identification of diseases in corn plants. Moreover, the high accuracy rates attained indicate the potential for real-time application in agricultural systems. By leveraging deep learning techniques, such as CNNs, this system demonstrates the capability to improve agricultural practices by efficiently detecting and addressing crop diseases.

Sandeep Kumar [3] proposed a system for Leaf Disease Detection and Classification based on Machine Learning, aiming to address the significant role of agriculture in the economy and the common occurrence of plant diseases, which profoundly affect agricultural productivity. In the agricultural sector, detecting infections in plants is crucial, as it helps in timely intervention to mitigate the impact of diseases on crop yields. Continuous monitoring of plants for disease symptoms requires significant human effort and time. Therefore, automating this process through a programmed strategy can simplify the detection of diseased leaves and save time and effort. The proposed algorithm aims to achieve more accurate identification and classification of plant diseases compared to existing techniques. By leveraging machine learning algorithms, the proposed system can effectively detect and classify diseases in plant leaves, thereby streamlining agricultural practices and contributing to improved crop management. This automated approach has the potential to enhance the efficiency and productivity of agricultural systems by enabling timely and accurate identification of plant diseases.

Melike Sardogan [4] developed a method for Plant Leaf Disease Detection and Classification based on Convolutional Neural Network (CNN) with the Learning Vector Quantization (LVQ) algorithm. Recognizing diseases in plants early is crucial for maintaining efficient crop yields in agriculture. Specifically, diseases like bacterial spot, late blight, Septoria leaf spot, and yellow curved leaf can significantly impact the quality of tomato crops. Automatic classification methods for plant diseases aid in taking timely action after detecting symptoms on the leaves. The paper presents a CNN model combined with the LVQ algorithm for detecting and classifying tomato leaf diseases. The dataset used contains 500 images of tomato leaves exhibiting the four symptoms of diseases mentioned earlier. The CNN model is utilized for automatic feature extraction and classification, with color information actively incorporated into the research. In this model, filters are applied to the three channels based on the RGB components of the images. The LVQ algorithm is then employed, utilizing the output feature vector from the convolutional part of the CNN for training the network. Experimental results demonstrate the effectiveness of the proposed method in recognizing the four different types of tomato leaf diseases. This approach showcases the potential of combining CNNs with LVQ algorithms for accurate and automated detection and classification of plant diseases, which is vital for maintaining crop health and productivity in agriculture.

Shima Ramesh [5] outlined a method for Plant Disease Detection Using Machine Learning, emphasizing the significant threat crop diseases pose to food security and the challenges in quickly identifying them due to the lack of necessary infrastructure in many parts of the world. The emergence of accurate techniques in leaf-based image classification has shown promising results in addressing this issue. The proposed method utilizes Random Forest, a machine learning algorithm, to distinguish between healthy and diseased leaves using datasets created for this purpose. The implementation of the method involves several phases, including dataset creation, feature extraction, training the classifier, and classification. In the dataset creation phase, sets of healthy and diseased leaves are compiled and labeled accordingly. Feature extraction is performed using Histogram of Oriented Gradient (HOG) to capture relevant information from the leaf images. These features are then used to train the Random Forest classifier, which learns to differentiate between healthy and diseased leaves based on the extracted features. The

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paper highlights the potential of using machine learning techniques to train on large publicly available datasets, enabling the detection of plant diseases on a large scale. By leveraging machine learning algorithms like Random Forest and techniques such as feature extraction, this approach offers a promising solution for addressing the challenges associated with plant disease detection, ultimately contributing to improved food security and agricultural productivity.

III. PROPOSED WORK

The proposed Plant Disease Detection system aims to leverage Convolutional Neural Networks (CNNs) for analyzing plant leaf images obtained from the comprehensive "Leaf Disease Dataset," which encompasses 39 different classes of plant diseases. These diseases include common issues such as powdery mildew and blight. The primary goal of the system is to accurately identify abnormalities in plant leaves, aiding in early detection and intervention.

To enhance accessibility and usability, the system will feature both a user-friendly website and a mobile application. Through these platforms, farmers can easily capture images of their plant leaves and upload them for disease diagnosis. The system will then provide instant feedback, classifying the leaves as healthy or diseased and, if applicable, specifying the particular disease detected.

In addition to facilitating disease detection, the platform will also serve as an educational resource for farmers. It will provide valuable information on disease management strategies, treatment options, and preventive measures. By empowering farmers with knowledge and actionable insights, the system aims to enable them to effectively combat plant diseases, ultimately improving crop yields and productivity.

Overall, the proposed system utilizes image processing methods, specifically CNNs, to automate the detection and diagnosis of plant diseases. By providing real-time feedback and educational resources, it seeks to assist farmers in making informed decisions and implementing effective strategies for maintaining plant health and maximizing agricultural output.

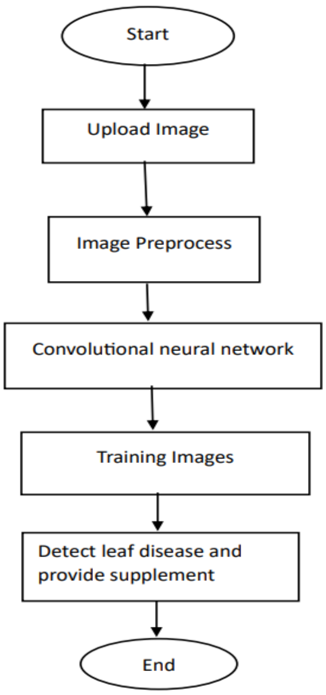

Figure 1: Flow chart

Fig.2 represents the architecture of the leaf disease detection system. The system architecture comprises of data

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acquisition from a huge dataset, processing at different convolutional layers and then the classification of plant diseases which declares the plant images is healthy or diseased.

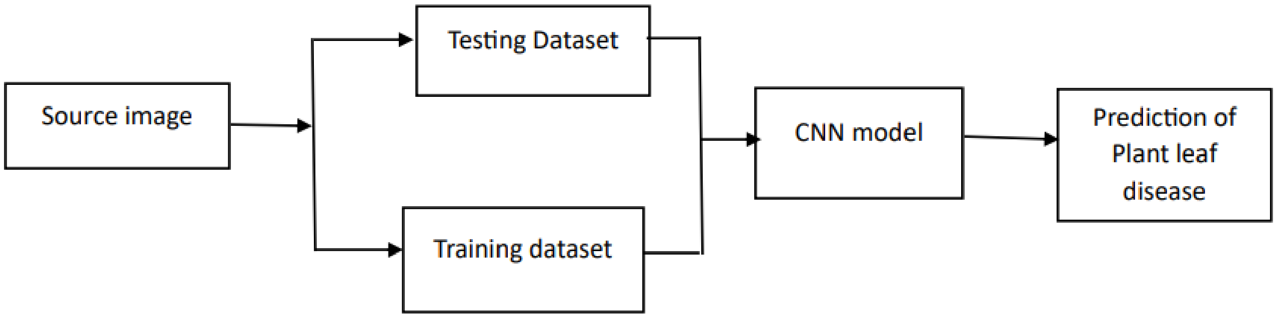

Figure 2: Architecture Diagram

Creating a leaf disease detection system using deep learning involves several essential modules or components. Here are the key modules used in such a system:

1. Data Collection and Preprocessing:
Data Collection: Gather a diverse dataset of plant leaf images, including healthy leaves and leaves with various diseases.
Data Preprocessing: Prepare the dataset by resizing, augmenting, and normalizing the images to ensure they are suitable for training the deep learning model.

2. Deep Learning Model:
Convolutional Neural Network (CNN): Design and implement a deep CNN for image classification, as CNNs are well-suited for image-related tasks. CNN stands for Convolutional Neural Network. It's a type of deep learning algorithm commonly used in image and video recognition, classification, and processing tasks. CNNs are inspired by the organization of the animal visual cortex, and they have proven to be highly effective in tasks such as object detection, facial recognition, and medical image analysis.

Key components of a CNN include:
a) Convolutional layers: These layers apply convolutional filters to input images to extract features such as edges, textures, and patterns.

b) Pooling layers: Pooling layers down sample the feature maps generated by the convolutional layers, reducing the spatial dimensions and the computational load.

c) Activation functions: Non-linear activation functions like ReLU (Rectified Linear Unit) introduce non-linearities into the network, enabling it to learn complex patterns in the data.

d) Fully connected layers: These layers connect every neuron in one layer to every neuron in the next layer, enabling the network to learn high-level features and make predictions.

CNNs are trained using large datasets, often requiring significant computational resources. Techniques such as transfer learning, where a pre-trained CNN is fine-tuned on a specific task, can help reduce the computational cost and training time for new applications.

3. Model Training:
Train the deep learning model using the preprocessed dataset, adjusting hyperparameters as needed.

4. User Interface:
Front-end: Develop a user-friendly interface (web or mobile) to allow users, such as farmers, to interact with the system. Back-end: Implement the logic for image processing and model interaction.
6. Disease Classification:

International Journal Of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

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Categorization: Classify detected diseases into specific categories. Information Retrieval: Provide detailed information about each disease, including causes and recommended treatments.
Each module plays a crucial role in the development and functionality of the leaf disease detection system, contributing to its effectiveness in helping farmers manage plant diseases and improve crop health.

IV. IMPLEMENTATION

Figure 3: Leaf care app

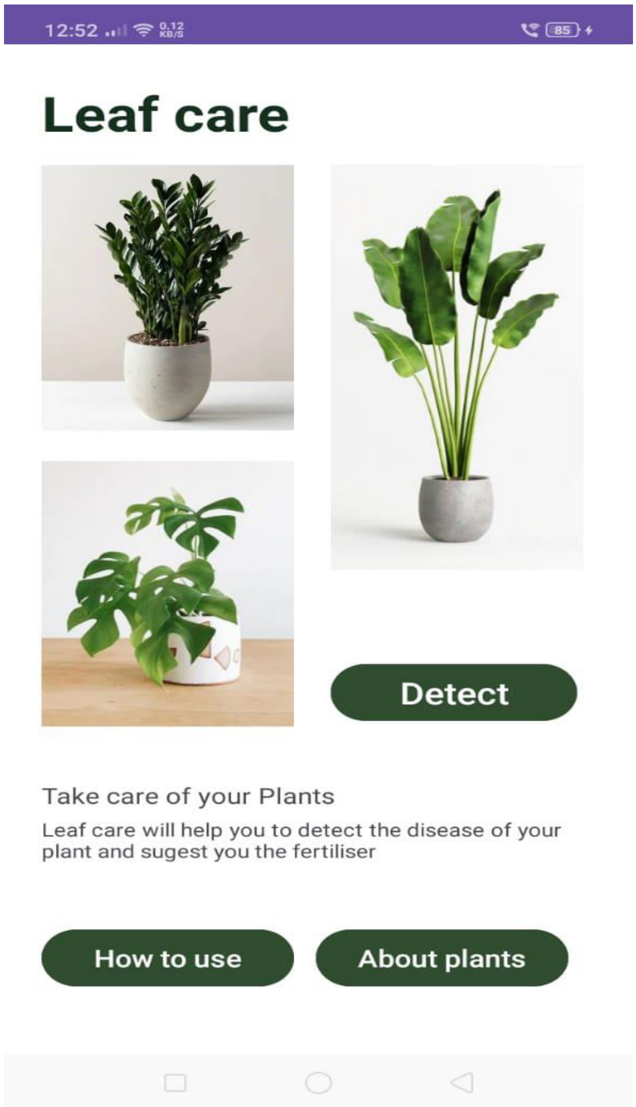

Figure 4: Home page

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Figure 5: use of app

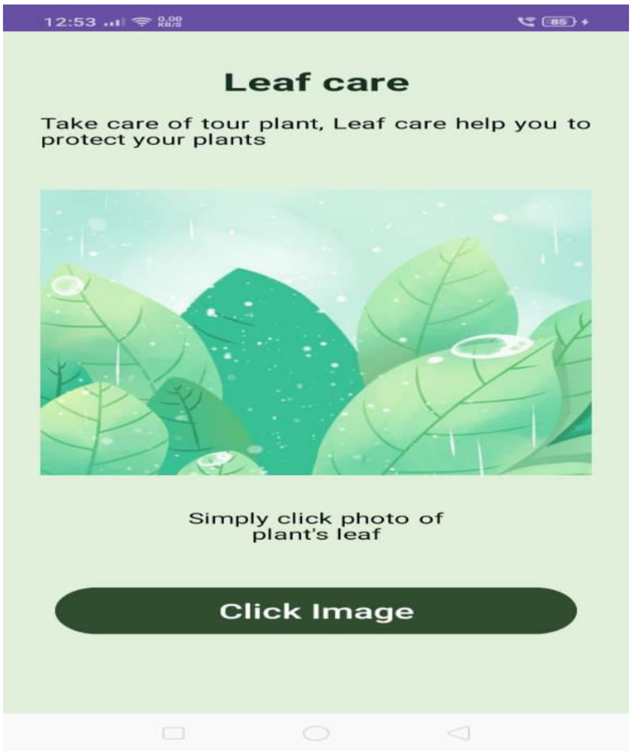

Figure 6: click Image

Figure 7: Detect Diseases of leaves

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Figure 8: More Information of clicked leaves and its supplements

Figure 9: About Plants

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Figure 10: Information about plants

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V. CONCLUSION

In conclusion, the development of a "Leaf Disease Detection system" has the potential to bring about significant benefits and applications in various fields. The project aimed to create a user friendly and efficient solution for identifying diseases in plant leaves, with a focus on agriculture and environmental monitoring. We create web-based application to ensure that give 96% accurate result. It concentrated on applying a CNN model to forecast the pattern of plant diseases using images from a given dataset (a trained dataset) in the field and historical data. Some of the benefits of this following findings regarding plant leaf disease prediction. This method will cover the greatest variety of plant leaves, allowing farmers to learn about leaves that may have never been cultivated. By listing all potential plant leaves, it aids farmers in choosing which crop to grow. Additionally, this technology takes historical data production into account, giving the farmer information into market prices and demand for specific plants.

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