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PLANT FOLIAGE ANALYSER

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Abstract: Agriculture is one of the main factor that decides the economic growth of any country. This is the one of the reasons that disease detection in plants plays an important role in agriculture field, as having disease in plants are quite natural. Plant disease identification is a significant process to prevent the losses in the quality and quantity of the agricultural product. It is essential to detect any disease in time to ensure healthy and proper growth of the plants prior to applying required treatment to the affected plants. Since manual detection of diseases costs a large amount of time and labour, it is inevitably prudent to have an automated system.With the worldwide increase in digital cameras and continuous improvement in computer vision domain, the automated techniques for detection of disease are highly possible. After necessary pre processing, the dataset was trained on using different deep learning algorithms. This approach of ours is to increase the productivity of crops in agriculture.We aim to raise awareness about the disease and also provide solutions to the disease using generative AI.

Keywords: Agriculture, Plant disease, Deep learning algorithms, Generative AI

INTRODUCTION

Agricultural productivity is a cornerstone of the economy, particularly in countries like India where it plays a vital role. With agricultural land serving more purposes than mere sustenance, the identification of diseases in plants becomes paramount. The Indian economy heavily relies on agricultural productivity, making it imperative to address issues such as disease outbreaks that can significantly impact crop yields. Plant diseases have a significant impact on production costs and farmers' livelihoods in addition to affecting the quantity and quality of produce.

Traditionally, farmers and plant pathologists have relied on visual inspection to detect diseases, drawing upon their experience and knowledge But this approach is time-consuming, prone to error, and frequently subjective. Moreover, diseases in their early stages may manifest similarly, leading to misdiagnosis and ineffective treatments. The reliance on visual inspection also necessitates the transmission of knowledge from generation to generation, which may not always be comprehensive or accurate. Consequently, there's a pressing need for more reliable and efficient disease detection methods that can empower farmers, particularly the younger and less experienced ones.

The lack of accurate and timely disease detection tools poses significant challenges to agricultural productivity. Disease outbreaks can lead to substantial losses in yield, quality, and profit for stakeholders in the agriculture sector. Moreover, the overuse of pesticides as a preventive measure against diseases further escalates production costs and environmental concerns. Therefore, developing automated disease detection techniques offers a promising solution to these challenges. By leveraging advancements in computer vision and in machine learning algorithms, it's possible to create robust systems capable of identifying disease symptoms with high accuracy and efficiency.

Automatic disease detection techniques offer several advantages over traditional methods. They not only reduce the laborious task of manual monitoring, especially in large farms, but also enable early detection of symptoms as soon as they appear on plant leaves. This early intervention can significantly mitigate the spread of diseases and minimize crop losses. Furthermore, automated systems can operate on a larger scale, covering vast agricultural areas with minimal human intervention. By harnessing machine learning and deep learning machine learning algorithms, these systems can continuously learn and improve their disease detection capabilities, ensuring more reliable results over time.

In conclusion, addressing the challenge of identification of plant disease crucial for maintaining agricultural productivity and ensuring food security. By transitioning from manual inspection to automated detection techniques, we can enhance the efficiency, accuracy, and scalability of disease detection processes. Empowering farmers with reliable tools and technologies not only benefits their livelihoods but also contributes to sustainable agriculture practices and economic prosperity. Therefore, continued research and investment in advanced technologies are essential to safeguarding the future of agriculture in India and beyond.

LITERATURE REVIEW

Bindu G. et al. clarifies Despite population expansion, agriculture is still important in this study [1], but farmers do not receive enough advice. In order to solve this, a system that makes use of cameras, IoT sensors, and machine learning algorithms analyzes soil data and instantly identifies crop illnesses. The system consists of two modules: one uses soil analysis to estimate crop production (NPP-WPF) and advise farmers on appropriate crops and resource requirements; the other module uses CNNs and other models to achieve 98.2% accuracy in early identification of illnesses in 38 classes affecting 14 plant species.**Diksha Tandekar et.al explains** In this paper, [2]In India, where over 50% of the population relies on agriculture, disruptions such as plant diseases and climate change pose significant threats. Leaf diseases, particularly challenging to identify, can cause substantial losses if untreated. Leveraging image-based detection, this study employs machine learning and deep learning algorithms like Random Forest Classifier, Support Vector Machine, K-Nearest Neighbours, and Convolutional Neural Network. Results favour Random Forest as the most effective classifier, offering promising prospects for accurately diagnosing and managing plant leaf diseases, thus mitigating agricultural risks. **Anagha Rai et.al explains** In this paper, [3]In addressing food security challenges in developing nations like India, early detection of plant diseases is vital. This article delves into employing Deep Learning models, notably Convolutional Neural Networks (CNN), to visually identify and classify various plant ailments. Utilizing platforms like Google Cloud/AWS and TensorFlow for preprocessing, the system achieves an impressive average classification accuracy of 97%. Moreover, by integrating machine learning algorithms, farmers can optimize crop selection based on soil type and receive tailored fertilizer recommendations, promising increased productivity and reduced crop losses.

Amit Kumar Mishra et al. clarifies In this work, [4] This method uses image processing, segmentation, and feature extraction to address the large losses in agricultural productivity caused by plant leaf diseases. K Nearest Neighbour (KNN) classification is the next step. With an astounding accuracy of 98.56%, it offers important information such as the name of the disease, the affected area, the total accuracy, the sensitivity, and the elapsed time. This method has the potential to reduce agricultural losses by efficiently identifying and treating plant leaf diseases. **Avr Mayuri et.al explains** In this paper, [5]In our country, where agriculture is a vital economic sector, addressing plant diseases is important for maintaining crop productivity and income. Traditional observation methods are limited, prompting the adoption of machine learning techniques for disease identification. This study employs a multi-stage approach involving dataset creation, image processing, segmentation, and feature extraction, culminating in a deep learning model, ANNCVA, achieving an impressive accuracy of 98.22% in categorizing various plant diseases. Leveraging data from Plant Village, the model effectively identifies diseases across pepper, tomato, and potato plants, offering promising prospects for sustainable agrarian growth and productivity**.S. Vijaya Shetty et al.,** In this work, [6]This work uses leaf pictures from 14 different crops to establish a machine learning-based method for early plant disease identification. Preprocessing methods improve the quality of the dataset, and a Convolutional Neural Network(CNN) model combined with Flask makes the web application user-friendly. Through the provision of insights into disease traits, interpretability analysis enables farmers to minimize crop losses and respond promptly. The approach has intriguing opportunities for remote and real-time crop health monitoring due to its scalability to different crops and integration with technologies such as drones and sensors.

K. Harshavardhan et.al explains In this paper, [7] Utilizing deep learning method like ResNet 34, plant leaf diagnosis can be automated, offering rapid and accurate identification of diseases. By training the model on a vast dataset of tagged leaf photos, users can upload images to a website and receive instant diagnoses along with treatment suggestions. This approach revolutionizes plant disease management, providing stakeholders with an accessible tool for healthier crops and sustainable agriculture. **N. Srikanth et.al explains** In this paper, [8] This investigation applies deep learning models to develop Plant Diseases Detection and Classification Networks (PDDC-Net), crucial for enhancing agricultural sector innovation. Preprocessing includes noise elimination and standardization of dataset images. Utilizing a ResNet-based CNN for feature extraction and classification, the PDDC-Net not only detects diseases but also suggests pesticides, benefiting farmers and e-agriculture applications. The model demonstrates sufficient accuracy for effective diseases detection and classification, ensuring the operation's success in promoting agricultural growth and innovation. **Pavan Kumar Illa et.al explains** In this paper, [9] Ensuring food security for a growing global population hinges on maintaining agricultural productivity amidst the threat of plant diseases. Agriculture, vital for economies worldwide, faces losses due to poor disease management. Early detection is crucial to mitigate these losses and optimize crop yields. Automated diseases detection using deep learning offers advantages like reduced labour and early symptom recognition. This research underscores the efficacy of deep learning algorithms in efficiently detecting and categorizing plant leaf ailments, leveraging advancements in this field for improved agricultural outcomes. **Supriya et.al explains** In this paper, [10] This research reviews recent studies on identification of plant diseases in agriculture using ML and DL models, focusing on publications from 2017 to 2022.The study elucidates results, datasets utilized, and identifies research gaps, informing future directions in achieving accurate and effective classifications of plant diseases, thereby advancing precision agriculture technology.

METHODOLOGY

Plant disease utilizing Convolutional Neural Networks(CNNs) includes a complex philosophy that use the force of profound learning and PC vision. CNNs are a sort of counterfeit brain network explicitly intended for handling visual information, making them appropriate for undertakings like picture order and item location. The philosophy commonly starts with the assortment of a different dataset containing pictures of solid plants along with plants impacted by different infections. These pictures are then preprocessed to upgrade their quality and standardize highlights like size and lighting conditions. Then, the CNN model is prepared on this dataset, where it figures out how to naturally extricate important elements from the pictures and group them into various sickness classes. During preparing, the model changes its inner boundaries through backpropagation and improvement strategies to limit order blunders. Once prepared, the CNN can precisely recognize the presence of sicknesses in new pictures by breaking down examples and surfaces normal for explicit illnesses. Tweaking and approval steps are frequently utilized to streamline the model's exhibition and guarantee its generalizability across various datasets and ecological circumstances. Generally, the philosophy of plant illness recognizable proof utilizing CNNs addresses a state of the art approach that offers promising outcomes regarding exactness, productivity, and versatility.

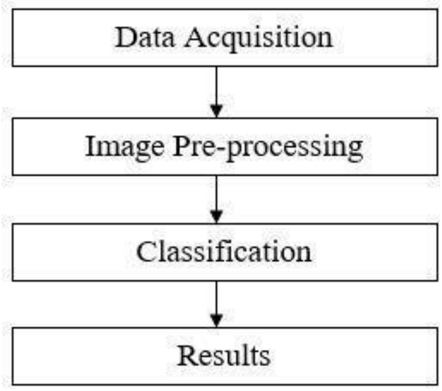

Fig: Detection and Classification Process

Data Acquisition

The leaf photos were gathered via the web resource Kaggle. The photos from 'Plant Village' are utilized to train the model. There are 41278 photos in the dataset for this image.Out of three different plants, this dataset is split into 19 distinct categories of plant diseases. There are both healthy and diseased leaves in the sample.

Image Preprocessing

Data should be converted in certain form so that future steps can work properly on it. This is done using Image Preprocessing. Image resizing and Normalization are done in this step.

1) Image Resizing: Firstly, images are resized to smaller pixel size in order to speed up the computations Transforms are applied to the images like resizing them from 256 * 256px to 128 * 128px.

2) Data Normalization: In order to make all the pixel values have the same mean and standard deviation, Normalization is applied. Normalization helps in getting the data within a range and also reduces the skewness which helps the model to learn faster and better. Normalizing the images means transforming the images into such values that the mean and standard deviation of the image become 0.0 and 1.0 respectively.

CNN (Convolutional Neural Network)

The Deep CNN constitutes a class of deep learning as a feed forward artificial neural network, and it is applied in several of the agricultural image classification works. The major reason why using CNN is beneficial is because it reduces the necessity of the feature extraction process. CNN is a neural network which comprises of four layers namely-Convolutional layer, Pooling layer, Fully connected layer and Activation function layer.

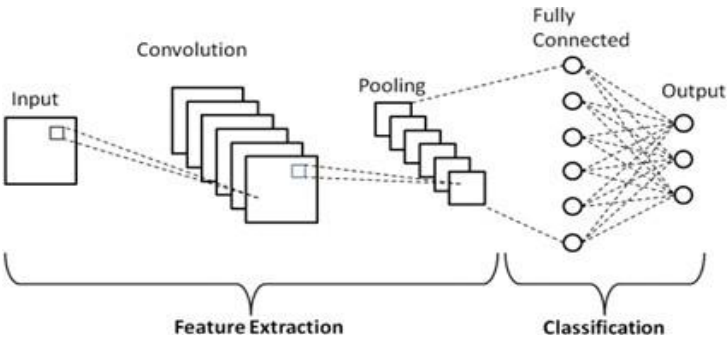

Fig: General architecture of CNN

1) Convolutional Layer

The different features from the input photos are first extracted using this layer. This layer performs the convolutional mathematical process between an input image and a specific size filter. The dot product between the filter and the portions of the input image, relative to the filter's size, is obtained by swiping the filter over the image. The output, known as the feature map, provides us with details about the image, including its edges and corners. This feature map is later supplied to additional layers so that they can identify more features from the input image.

2) Pooling Layer

A Pooling Layer comes after a Convolutional Layer. This layer's functions include decreasing the size of the image and extracting the most prominent characteristics. Reducing the connections between layers and performing independent operations on every feature map is how this is accomplished. While filters of various sizes can be used in this layer, 2*2 filters are typically recommended. Max pooling and average pooling are the two main types of pooling layers that are employed. The largest element in a feature map is used in max pooling. The average of the components in an Image segment of a predetermined size is determined by average pooling.

3) Full Connected Layer

The neurons are connected between two different layers by the Fully Connected (FC) layer, which also includes the weights and biases. These layers make up the final few layers of a CNN architecture and are often positioned before the output layer. FC layers are only employed when the sequence of convolutional plus pooling layers has sufficiently shrunk the image size to prevent the fully connected layers from needing to learn a significant number of parameters. This involves flattening and feeding the input image from the earlier levels to the FC layer. The mathematical function operations often occur in a few more FC layers after the vector has been flattened. At this point, the process of classification starts.

4) Activation layer

Since it is in charge of the network's nonlinear learning, the activation layer is crucial to any neural network. All of the input matrix's (or volume's) elements receive an activation function. Thus, for this layer, the input and output dimensions are the same. Numerous widely-utilized activation functions exist, including the Sigmoid, ReLU, Softmax, and tanH functions. The main reason the ReLU function is utilized is that it speeds up learning.

Sequence Diagram

An object's interactions are arranged chronologically in a sequence diagram. It shows the objects that are a part of the scenario and the messages that are sent between them in order for the scenario to function.

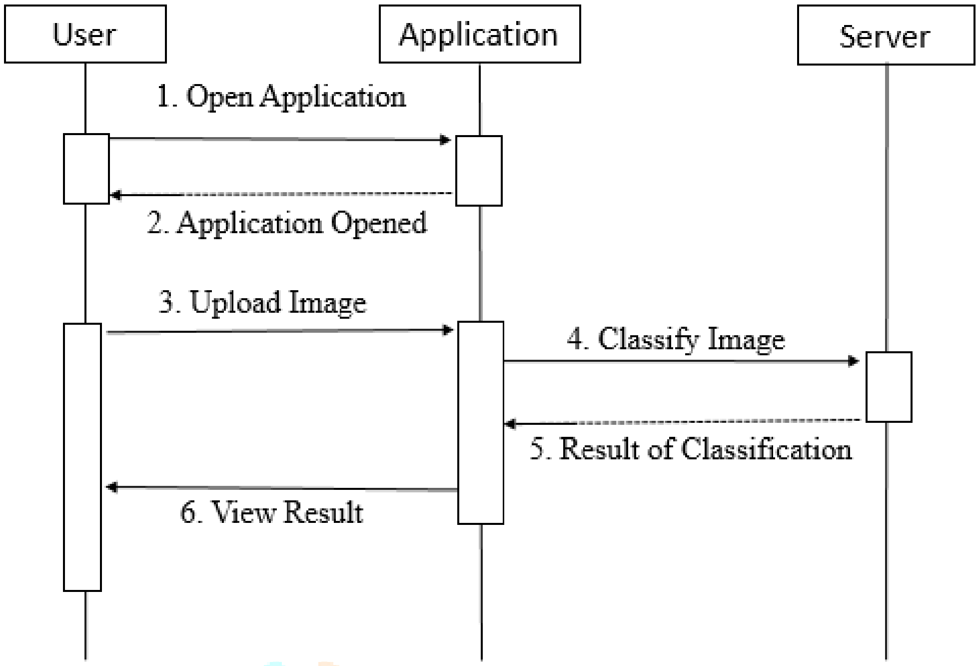

Fig: Sequence Diagram

RESULTS AND DISCUSSION

In this plant disease identification research, a multifaceted strategy is necessary in order to address the urgent issues that agricultural communities around the world are facing. Employing advanced technology of Convolutional Neural Networks(CNNs) for image classification has shown promising results in accurately detecting and diagnosing plant diseases. Additionally, efforts are being directed towards developing user-friendly interfaces and mobile applications that enable real-time disease detection in the field. By integrating these solutions into the research framework, stakeholders in agriculture can access timely and actionable insights to combat plant diseases effectively, thereby safeguarding crop yields, ensuring food security, and promoting sustainable agricultural practices.

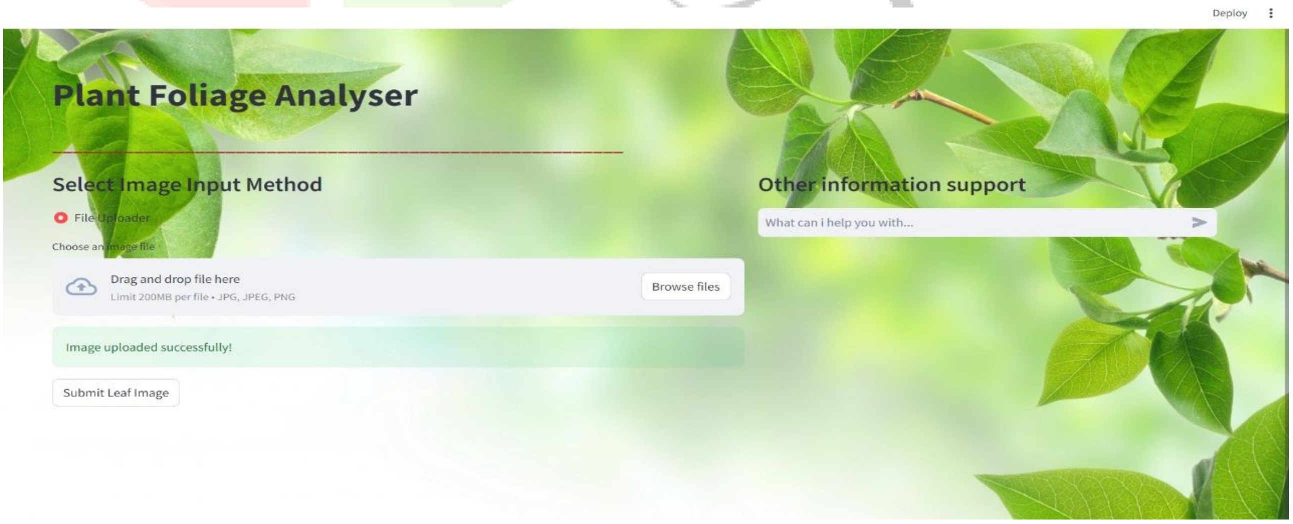

Fig: Website to upload the photo of the leaf for analysis

In order to begin the process of identifying leaf diseases using an online interface, users must first provide a clear picture of the leaf specimen. The picture goes through a number of preprocessing stages after it is uploaded in order to improve its quality and standardize its format. Resizing the image to a consistent dimension and improving its resolution can be necessary for this. The preprocessed picture is then sent into an advanced system for identifying diseases, which is frequently based on Convolutional Neural Networks(CNNs), which examine the picture to find signs of disease.

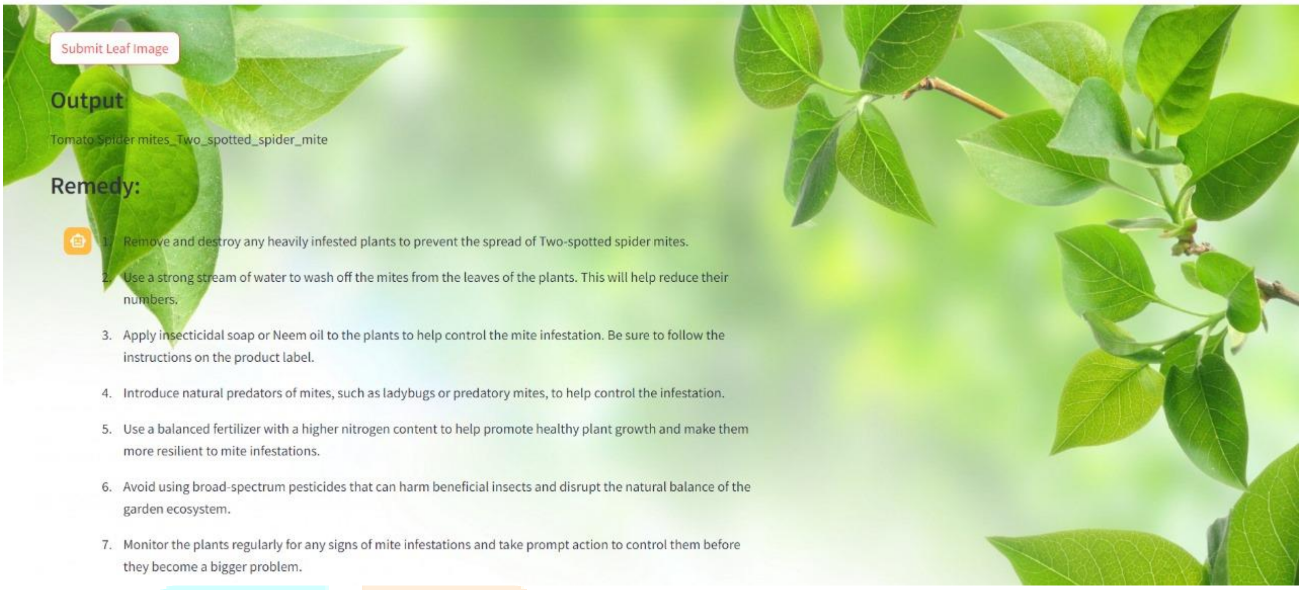

Fig: Detection of plant disease and providing remedy

The system then produces an extensive report that includes information on the ailment that was identified, possible fixes, and therapy suggestions. These solutions could be focused pesticide applications, crop rotation plans, or recommendations for managing soil health. They could also include particular measures for managing diseases. An interface like this for a website is essential for enabling farmers and other stakeholders to fight leaf disease and improve crop health.

CONCLUSION

A very accurate artificial intelligence system for recognizing and categorizing different plant leaf diseases is shown in this study. The study shows that the custom CNN model, which was trained on the "Plant Village Dataset," which consists of images from 19 distinct classes, successfully detects and diagnoses diseases from leaf photos. It does this by using convolutional neural network(CNN). Notably, the best results were obtained with remarkably little computing work, demonstrating the effectiveness of the suggested method in the identification and categorization of diseases. Additionally, this technique makes it possible to identify plant diseases at an early stage. A website that makes the model easy to use and offers treatments for the ailments that are categorized is created in an effort to improve accessibility. encouraging farmers to use it and optimizing the usefulness of the suggested solution

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