Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 5, No.4, May : 2024

CROP MONITORING AND OPTIMIZATION PLATFORM

Chinnabathini Arogya vamshi , Dr. A. Srinivasa Rao, G. Pavan kumar,Sk. Nagur Meera
Department of Computer Science & Engineering, Andhra Loyola Institute of Engineering and Technology, Vijayawada-520008 A.P., India. Email: arogyavamshi2002@gmail.com
akkella.srinivas08@gmail.com snagurmeera1@gmail.com pavankumargona765@gmail.com

Abstract—
In this project, we have developed a crop health monitoring system aimed at assisting farmers in identifying visible diseases in crop leaves and mitigating the spread of such diseases throughout the field. And recommendation of fertilizer and pesticides farmers can upload pictures of diseased areas of plants to a web or Android application for disease detection. Upon detection, farmers can take necessary actions to restrict the spread of the disease and implement appropriate remedies.
Keywords-- Crop health, leaf diseases, web application, CNN.

INTRODUCTION

Plant diseases can be classified based on various factors. Visible plant diseases can be classified depending on the cause of the disease, namely biotic and abiotic factors. Biotic factors include fungi, bacteria, slime molds, viruses, parasitic angiosperms, algae, insects, mites, nematodes, etc. Abiotic factors encompass soil moisture imbalance, nutritional disorders, optimal temperature imbalance, light intensity imbalance, gas, smoke, and other air pollutants, as well as careless spraying of chemicals. Currently, infectious diseases in plants reduce potential yields by almost 40%, with many farmers experiencing yield losses as high as 100%. Our focus lies in detecting leaf diseases such as leaf blight, leaf spot, rusts, powdery mildew, downy mildew, etc. This paper explores various plant leaf diseases. For example, apple trees can be affected by three main fungal diseases: cedar apple rust, apple scab, and frog eye leaf spot. Cherry trees are susceptible to Prunus spp., a fungal disease. Corn plants can suffer from three fungal diseases: corn grey leaf spot, common rust of corn maize, and leaf blight. Grape fruit leaves may be affected by three fungal diseases: black rot, black measles, and leaf blight. Bacterial diseases are commonly observed in oranges (citrus greening), peaches (bacterial spot), bell peppers (bacterial leaf spot), etc . . Potato crops are vulnerable to two different categories of fungal diseases: early blight and late blight. Squash and strawberries can be afflicted by the fungal disease powdery, powdery mildew and strawberry leaf scorch, respectively. Tomato plants exhibit a wide range of diseases including fungal diseases like early blight, Septoria leaf spot, target spot, and Passaiora. Additionally, they can be affected by bacterial, mold, and viral diseases such as bacterial leaf spot, late blight, and acari: Tetranychidae. In the category of mite diseases, there are two leaf diseases: tomato leaf curl and tomato mosaic virus.

II. LITERATURE REVIEW

Application of Machine Learning in Plant Disease Detection:
Various studies have explored the application of machine learning techniques, including CNNs, in plant disease detection. For instance, Mohanty et al. (2016) utilized deep learning algorithms to classify plant diseases accurately. Their research demonstrated the potential of machine learning in automated disease diagnosis, leading to improved crop management practices.
CNNs for Crop Disease Classification:
Convolutional Neural Networks (CNNs) have emerged as a powerful tool for crop disease classification. In their study, Barbedo (2019) evaluated the performance of CNNs in identifying plant diseases from images. The research highlighted the effectiveness of CNN architectures in achieving high accuracy and robustness in disease classification tasks.

Integration of Soil Monitoring with Disease Detection:

Some studies have focused on integrating soil monitoring with disease detection for comprehensive crop health management. For example, Pajares et al. (2015) proposed a system that combines image analysis for disease detection with soil sensing technologies. Their research emphasized the importance of considering soil conditions in conjunction with plant health for effective disease management strategies.

Challenges and Future Directions:

Despite the advancements in machine learning-based disease detection systems, several challenges remain. For instance, the limited availability of labelled datasets poses a significant obstacle to training accurate models. Additionally, the deployment of such systems in real-world agricultural settings requires consideration of factors such as scalability, reliability, and accessibility.

Potential Impacts and Benefits:

Implementing machine learning-based disease detection systems in agriculture holds promise for enhancing crop productivity, reducing losses, and promoting sustainable farming practices. By enabling early detection and timely intervention, these systems can help farmers make informed decisions, optimize resource utilization, and mitigate the spread of diseases.

Emerging Trends and Technologies:

Emerging trends in plant disease detection research include the integration of remote sensing techniques, such as drones and satellites, for large-scale monitoring of crop health. Additionally, advancements in sensor technologies and Internet of Things (IoT) devices offer opportunities for real time monitoring and decision support in precision agriculture applications.

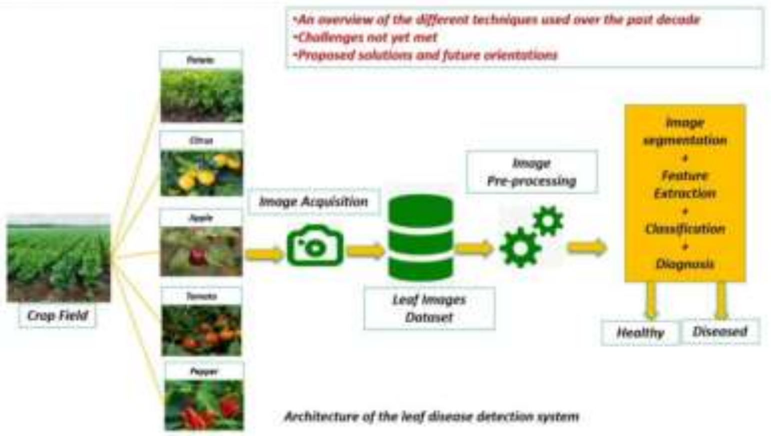
METHODOLOGY

Creating Plant Disease Detection Model:

The plant disease detection model was created using Deep learning. Initially, the dataset was imported, with 80% used for training and the rest for testing. The pre-trained ResNet 34 model was employed for deeper learning. After importing the dataset and libraries, the path for the dataset was defined. Labels of all folder names were obtained using the ImageDataBunch.from_folder function. The data was then normalized to Imagenet parameters. A random sample of images can be printed using the show_batch() function. The CNN learner function was used to create a transfer model, and metrics were printed. After training the model for 5 epochs, an accuracy of up to 99% was achieved. Finally, the model was saved, and the trained data was interpreted by plotting graphs of Loss vs. Learning rate.

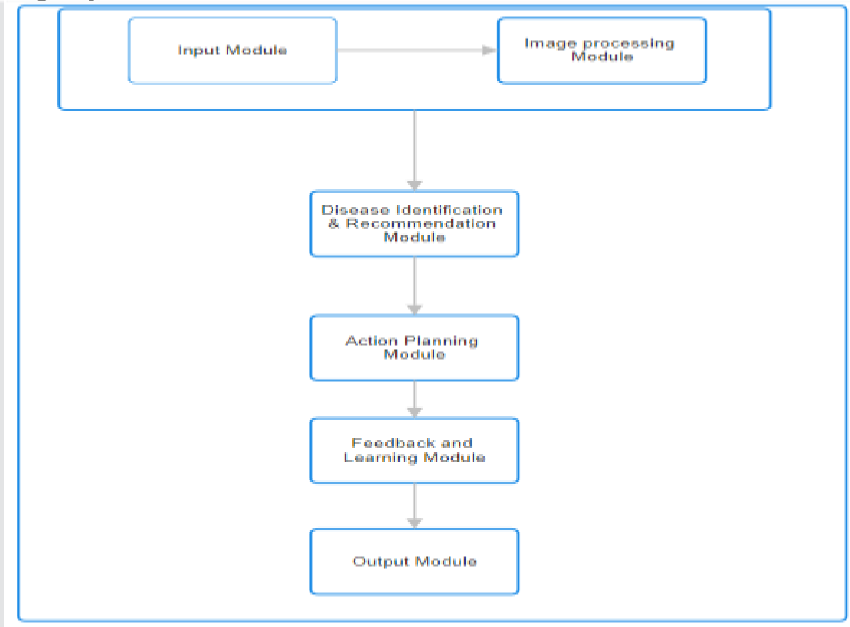
Converting Trained Model into a Web Application.

The necessary packages were downloaded, including Flask as the framework. Next, the previously trained model was loaded. After this, the classes to be detected by our application were defined. This serves as the opening page of our website. Some changes were made to the HTML page to enhance user-friendliness, such as adding options to upload images from the computer and clicking on the analyse button to get the predicted result.



Architecture of the leaf disease detection system

This application can now run on a local machine. To make it accessible to a wider audience, it can be deployed using any of the docker-hosted services, such as AWS, Azure web app, IBM Softlayer, etc.



III. RESULTS

The results of the project include the successful detection of plant diseases from uploaded images and providing appropriate suggestions to farmers. Here's how the results are achieved:

Image Disease Detection:

Upon uploading an image of a diseased crop leaf, the web application processes the image using the trained disease detection model. The model analyses the image and identifies the type of disease present on the crop leaf. The detected disease is then displayed to the user, providing valuable information about the condition of their crops.

2. Suggestion for Mitigation:

Based on the detected disease, the web application provides suggestions to farmers on how to mitigate the issue. Suggestions may include recommendations for specific pesticides, fungicides, or cultural practices to control the spread of the disease. Additionally, the application may offer advice on preventive measures to avoid future occurrences of the detected disease.

V. DISCUSSION

The literature review underscores the significant progress made in utilizing machine learning, particularly Convolutional Neural Networks (CNNs), for the detection and classification of plant diseases. This discussion will delve into several key points highlighted in the literature review and provide insights into the implications for research paper development.

1. Efficacy of Machine Learning in Disease Detection:

The literature review highlights the effectiveness of machine learning techniques, especially CNNs, in accurately identifying plant diseases from images. This underscores the potential of these algorithms in automating disease diagnosis, which can significantly improve crop management practices. In the research paper, it would be essential to discuss specific studies demonstrating the performance and accuracy of machine learning models in disease detection tasks, emphasizing the importance of robust training datasets and model validation techniques.

2. Integration of Soil Monitoring and Disease Detection:

The integration of soil monitoring with disease detection represents a novel approach to comprehensive crop health management. By considering soil conditions alongside plant health indicators, farmers can make more informed decisions regarding disease prevention and treatment strategies. In the research paper, it would be valuable to explore the potential synergies between soil sensing technologies and image-based disease detection systems, discussing how combined data analysis can enhance overall crop management practices.

3. Challenges and Future Directions:

Despite the advancements in machine learning-based disease detection, several challenges persist, including dataset availability and deployment considerations. Discussing these challenges in the research paper provides an opportunity to identify areas for future research and development. For instance, addressing the need for larger and more diverse labelled datasets can improve the generalization capabilities of machine learning models. Additionally, exploring scalable and accessible deployment strategies can facilitate the adoption of these technologies by farmers worldwide.

4. Potential Impacts and Benefits:

The potential impacts of machine learning-based disease detection systems on agriculture are substantial, ranging from increased crop productivity to reduced losses and enhanced sustainability. It is crucial to discuss these potential benefits in the research paper, highlighting the broader implications for food security and agricultural sustainability. Moreover, discussing case studies or real-world applications where machine learning systems have been successfully deployed can provide concrete examples of their efficacy and impact.

5. Emerging Trends and Technologies: The discussion of emerging trends and technologies in plant disease detection research offers valuable insights into future directions for research and development. In the research paper, it would be beneficial to explore promising avenues such as the integration of remote sensing techniques and IoT devices for real-time monitoring and decision support in precision agriculture. Additionally, discussing the role of interdisciplinary collaboration in advancing plant disease detection research can shed light on innovative approaches and methodologies.

VI. CONCLUSION

The successful detection of plant leaf diseases using machine learning has been achieved. The CNN machine learning algorithm is employed for the detection and classification of crop diseases by training the datasets. The system is implemented for early detection of crop diseases and necessary precautions. The analysis and detection of various crop diseases through photos are carried out successfully, along with the monitoring of soil parameters.

VII. REFERENCES

[1] National Plant institute of diseases open schooling: http://oer.nios.ac.in/wiki/index.php/PlantDiseases [2] An open access repository of images on plant health to enable the devel-opment of mobile disease diagnostics https://arxiv.org/abs/1511.08060

[3] Belal A. M. Ashqar, Samy S. Abu-Naser, “Image-Based Tomato Leaves Diseases Detection Using Deep Learning” International Journal of Aca-demic Engineering Research, Vol. 2 Issue 12, December – 2018.

[4] Plant Village https://arxiv.org/ftp/arxiv/papers/1511/1511.08060.f

[5] T.Gayathri, S.Ragul, S.Sudharshanan, “CORN FARMLAND MONITOR-ING USING WIRELESS SENSOR NETWORK”, International Research Journal of Engineering and Technology, Volume: 02 Issue: 08, Nov 2015.

[6] Arduino IDE https://www.arduino.cc/en/main/software

[7] Jupyter Notebook https://jupyter.org/ [8] Fast.ai https://docs.fast.ai/

[9] Resnet-34 https://www.kaggle.com/pytorch/resnet3