Crop Disease Detection Using ML Health Assistance Chatbot

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Abstract:
Agriculture is one of the most important sectors, but crop diseases often cause heavy losses for farmers. Many farmers struggle to identify plant diseases at an early stage because it requires expert knowledge and regular monitoring, which is not always available. To solve this problem, we propose a smart system that uses deep learning, specifically a Convolutional Neural Network (CNN), to automatically detect crop diseases from images. In this system, farmers can easily upload a picture of the affected crop through a mobile or web application. The CNN model then analyzes the image and predicts whether the crop is healthy or infected. If a disease is detected, the system provides detailed information about the disease, its symptoms, preventive measures, and the right products (like pesticides or fertilizers) that can help in controlling it. This helps farmers take quick action before the disease spreads further. To make the solution more interactive and farmer-friendly, the system also includes a chatbot. The chatbot allows farmers to ask questions in simple language about crop care, diseases, or best farming practices, and receive instant guidance. By combining image-based disease detection with an AI-powered chatbot, the system not only diagnoses crop health problems but also becomes a 24/7 virtual assistant for farmers.

Keywords: Crop Disease Detection Convolutional Neural Network (CNN) Deep Learning Image Classification Precision Agriculture Chatbot Assistance Smart Farming.

INTRODUCTION

Farming is the backbone of our country, but farmers often face big challenges when their crops get affected by diseases. Identifying these diseases at the right time is very important because even a small delay can lead to huge losses in crop yield and income. Most farmers depend on manual observation or advice from experts, but this process is time-consuming, costly, and not always reliable.

With the help of modern technology, especially Artificial Intelligence (AI), we can make this process faster and easier. In this project, we use a Convolutional Neural Network (CNN) model to detect crop diseases automatically from images. Farmers just need to take a picture of their plant and upload it to the system. The system will then analyze the image, identify if there is any disease, and give useful suggestions such as precautions and recommended products to control it.

To make the solution more helpful, we also include a chatbot where farmers can ask questions in simple language about their crops, diseases, or farming practices. This makes the system act like a virtual farming assistant that is available anytime.

By combining AI-powered image analysis with an interactive chatbot, this system aims to reduce crop damage, save farmers' time, and increase overall productivity in agriculture.

LITERATURE SURVEY

Mohammad Anwar Hossain, Newaz Ibrahim Khan, Noshin Un Noor, Fazle Rabby, Ashiqur Rahman and Hridoy Chandra Shill, "Crop health analysis system: Integrating machine learning for disease detection in agricultural images", International Journal of Computing and Artificial Intelligence 2025. This project introduces an innovative approach to detecting plant diseases using the latest technology in artificial intelligence. By combining Convolutional Neural Networks (CNNs) for extracting important image features and the ResNet-50 model for classifying those features, the system can accurately identify crop diseases from images. Through a structured image classification process that includes collecting, processing, and enhancing data, the model achieves high accuracy and efficiency in disease detection. A key highlight of the project is the integration of this advanced machine learning model with a user-friendly web application built using Streamlit. This allows farmers to easily upload images and receive instant disease diagnoses online. When compared to the standard ResNet-50 model, the optimized version used in this project shows improved performance, reaching an impressive 98.72% accuracy. This system not only matches but surpasses traditional methods in terms of speed, accuracy, and scalability. The project also takes into account both technical requirements (like reliable datasets) and broader qualities such as ease of use, resilience, and the ability to adapt to various agricultural conditions. What sets this solution apart is its ability to serve both small and large-scale farms, adapt to changing environments, and support sustainable farming. By helping farmers detect diseases early, this system can lead to higher crop yields, reduce the need for pesticides, and contribute to global food security. It's a strong example of how machine learning can transform agriculture and create real-world impact.[1]

Chatla Subbarayudu and Mohan Kubendiran, "A Comprehensive Survey on Machine Learning and Deep Learning Techniques for Crop Disease Prediction in Smart Agriculture", Nature Environment and Pollution Technology An International Quarterly Scientific Journal 2024. This paper presents a detailed review of various AI-based methods used for predicting crop diseases. It explores and compares a wide range of research studies, focusing on the techniques used, key parameters, and performance outcomes. The review also identifies the strengths and limitations of each approach. To demonstrate the practical impact of these technologies, a case study is included that shows how a shift towards deep learning can lead to the development of a more accurate and efficient disease prediction model. The study also highlights current research gaps and suggests directions for future work. Based on the survey, deep learning methods have been found to outperform traditional machine learning approaches in terms of accuracy and reliability, showing strong potential in reducing crop loss and improving agricultural productivity.[2]

Dr.Sonali Kothari, Dr. Pooja Bagane, Manasvi Mishra, Saloni Kulshrestha, Yashika Asrani, Vrinda Maheswari, "CropGuard : Empowering Agriculture with AI driven Plant Disease Detection Chatbot", International Journal of Intelligent Systems And Applications In Engineering 2024. Crop diseases, mostly caused by bacteria and fungi, continue to be a major threat to crop quality and food production around the world. For many farmers, especially in developing countries, spotting these diseases early is a real challenge. It often requires trained experts, which can be both expensive and time-consuming. However, with the rise of smart devices and AI, there's now a real opportunity to automate disease detection, making it faster, more affordable, and more accessible. In today's world—where climate change, shifting disease patterns, and increasing food demand are putting more pressure on agriculture—farmers need smarter tools to stay ahead. Unfortunately, many of the tools currently available are either too complex or out of reach. That's why we created CropGuard. It's an AI-powered chatbot designed to help detect plant diseases quickly and easily. The system brings together a user-friendly interface built with Streamlit, powerful deep learning models for analyzing plant images, and GPT-3.5 Turbo to allow natural, helpful conversations with users. What makes CropGuard truly stand out is its ability to learn and improve over time. By using feedback from users and new data, the chatbot gets better with each interaction—becoming more accurate and more useful as it goes. Our goal is to give farmers a smart, evolving tool that helps them protect their crops, improve yields, and adapt to the ever-changing world of agriculture. [3]

Pitchayagan Temniranrat , Kantip Kiratiratanapruk , Apichon Kitvimonrat, Wasin Sinthupinyo , Sujin Patarapuwadol , "A System for Automatic Rice Disease Detection from Rice Paddy Images Serviced via a Chatbot", arXiv:2011.10823v2 [eess.SY] 23 Jun 2021. In this study, developed and presented a LINE Bot system designed to diagnose rice diseases using real images captured directly from paddy fields—without the need for any special sample preparation. The goal was to create an easy-to-use, fully automated tool that could help rice farmers improve both the yield and quality of their crops. We applied deep learning techniques, specifically neural networks, to detect diseases in rice plants from these images. To improve upon our previous work on rice leaf disease detection, we implemented a refined training process for our object detection model. This involved analyzing the model's predictions and using those insights to enhance the quality of the training dataset for future iterations. Among the techniques tested, YOLOv3 emerged as the most effective, and we used it to build the deployment model for the LINE Bot. Trained on the refined dataset, the model's performance improved significantly, with the Average True Positive Point increasing from 91.1% in our earlier research to 95.6% in this study. The deployed LINE Bot provided real-time disease diagnosis suggestions within LINE groups that included both rice farmers and agricultural specialists, allowing for quick communication and expert feedback. In actual use, the system achieved an average accuracy of 78.86% and was able to deliver results in just 2–3 seconds, making it both fast and practical for everyday farming use. [4]

Moshiur Rahman Tonmoy , Md. Mithun Hossain , Nilanjan Dey, "MobilePlantViT: A Mobile-friendly Hybrid ViT for Generalized Plant Disease Image Classification", arXiv:2503.16628v1 [cs.CV] 20 Mar 2025. lant diseases pose a serious threat to global food security by lowering crop yields and impacting sustainable farming practices. Ths paper introduce MobilePlantViT—a lightweight yet powerful hybrid Vision Transformer (ViT) model designed specifically for plant disease classification. Our goal was to build a model that is both efficient and accurate, making it suitable for real-world smart agriculture applications, even in low-resource settings. We tested MobilePlantViT across a wide range of plant disease datasets and found it to be highly effective and generalizable, achieving test accuracies from 80% to over 99%. What's particularly noteworthy is that our model has only 0.69 million parameters, yet it outperforms the smaller versions of MobileViTv1 and MobileViTv2, both of which have more parameters. This highlights the strength of our design in balancing performance with efficiency. We believe MobilePlantViT offers a practical and scalable solution for AI-powered plant disease detection, especially in sustainable and resource-constrained agricultural environments. [5]

Konstantinos I. Roumeliotis, Ranjan Sapkota, Manoj Karkee, Nikolaos D. Tselikas, and Dimitrios K. Nasiopoulos, "Plant Disease Detection through Multimodal Large Language Models and Convolutional Neural Networks", IEEE Transactions, Automation in agriculture is becoming increasingly important, especially for tackling challenges like crop monitoring and early disease detection. In this study, explore how combining advanced AI tools—specifically multimodal Large Language Models (LLMs) like GPT-4o—with Convolutional Neural Networks (CNNs) can improve plant disease identification using leaf images. Using the well-known PlantVillage dataset, we tested how well these models performed under different training scenarios, including zero-shot (no prior examples), few-shot (a handful of examples), and progressive fine-tuning. We focused on two plant species—apple and corn—and tested image resolutions of 100, 150, and 256 pixels to simulate different quality levels. When comparing GPT-4o to the popular ResNet-50 CNN model, we found that the fine-tuned GPT-4o slightly outperformed ResNet-50, reaching up to 98.12% accuracy on apple leaf images, compared to 96.88% for ResNet-50. GPT-4o also showed better generalization and minimal training loss. However, its performance in zero-shot settings was much lower, highlighting the importance of even minimal training to unlock its full potential. We also examined how well the models could adapt across different resolutions and plant types. These tests revealed both the strengths and limitations of the models when applied outside their original training conditions.[6]

Maruti Saisurya Rajanala1, Muppirisetti Sivakiran, Manduva Sai Revanth, Ms. S. Subbulakshimi, Ms. Priyanka G, Dr Anand M, " Agricultural Chatbot Voice Assistant Using NLP Techniques", International Journal on Science and Technology (IJSAT)2025. This paper presents the Agriculture Chatbot Voice Assistant (ACVA)—an innovative virtual advisor powered by Multi-Layer Perceptron (MLP) neural networks and Natural Language Processing (NLP) techniques. ACVA is designed to provide farmers with real-time insights and personalized recommendations, helping them make informed decisions across various aspects of farming. By leveraging MLP, the system can analyze complex agricultural data, including soil health, weather conditions, and crop characteristics, to offer tailored guidance on crop management, pest control, and market trends. With built-in NLP capabilities, ACVA understands and responds to farmers' questions in natural, conversational language. The addition of voice recognition technology makes the system even more accessible, allowing farmers to engage with it seamlessly—even in remote or hands-free environments. Overall, ACVA has the potential to transform agricultural decision-making by promoting sustainable practices and improving farm productivity through intelligent, user-friendly support.[7]

Shima Ramesh, Mr. Ramachandra Hebbar, Niveditha M, Pooja R, Prasad Bhat N, Shashank N, Mr. P V Vinod, "Plant Disease Detection Using Machine Learning", 2018 International Conference on Design Innovations for 3Cs Compute Communicate Control. Crop diseases pose a significant threat to global food security, yet rapid and accurate identification remains a challenge in many regions due to the lack of proper infrastructure. This paper explores the use of a Random Forest classifier to distinguish between healthy and diseased leaves using custom-created datasets. Our approach involves several key stages: dataset creation, feature extraction, classifier training, and image classification. For feature extraction, we employ the Histogram of Oriented Gradients (HOG) method to capture relevant visual patterns in the leaf images. The compiled dataset—comprising both healthy and diseased leaf samples—is used to train the Random Forest model, enabling it to accurately classify new inputs. By leveraging machine learning on large, publicly available datasets, this study presents a scalable and effective method for detecting plant diseases, potentially transforming disease management in agriculture at scale.[8]

Deepkiran Munjal, Laxman Singh, Mrinal Pandey, Sachin Lakra, "A Systematic Review on the Detection and Classification of Plant Diseases Using Machine Learning", International Journal of Software Innovation. In this study, review and evaluate the latest state-of-the-art machine and deep learning methods for plant disease detection. Additionally, we highlight the limitations and challenges these technologies face, aiming to shed light on areas where future improvements can enhance their practical usability in agriculture. These modern approaches have even outperformed traditional image processing methods and, in some cases, human experts in accuracy and efficiency. Over the years, many researchers have applied various ML and DL techniques to diagnose a wide range of plant ailments, offering new hope to farmers and landowners for timely intervention.[9]

Pallepati Vasavi, Arumugam Punitha, Thota Venkat Narayana Rao, "Chili Crop Disease Prediction Using Machine Learning Algorithms", Revue d'Intelligence Artificielle Vol. 37, No. 3, June, 2023. This study evaluates the performance of several machine learning algorithms—including Random Forest (RF), AdaBoost, Gradient Boosting (GB), and Multi-Layer Perceptron (MLP)—for predicting diseases in chili crops using image data. We utilize a novel dataset, the Real Chili Crop Field Image Dataset, containing approximately 1,157 images categorized into five distinct disease classes. Experimental results show that the Random Forest and Gradient Boosting algorithms achieve the highest accuracies, at 96% and 94% respectively. Notably, this dataset was collected under natural, uncontrolled field conditions, enhancing the real-world applicability of the findings. To improve classification performance, the study incorporates diverse and widely-used feature extraction methods, such as Haralick and Hu moments, combined with the Random Forest classifier. Overall, this work highlights effective machine learning strategies for practical, field-based disease detection in chili crops.[10]

Sharvari V. Patil, Anjali K. Sharma, Bhagyashree R. Kamble, Kajal B. Jadhav, “Cotton Leaf Disease Detection Using Deep Learning”, International Journal of Creative Research Thoughts (IJCRT) Volume 10, Issue 5 May 2022. This project aims to develop an end-to-end web application that can analyze diseases on cotton plants using deep learning algorithms. Beyond detection, the application will also provide farmers with tailored recommendations for products to control or eliminate the diseases effectively. To achieve this, we first gathered a dataset of approximately 1,752 images—around 440 images per category—covering three major cotton diseases: sucking and chewing pest damage, bacterial blight, and curl virus disease. The model will be trained and developed using tools available in the Anaconda environment, such as Jupyter Notebook and Spyder. This project demonstrates the feasibility of deploying AI-driven solutions for real-time disease diagnosis in cotton cultivation and highlights the growing importance of IT-based support systems to complement traditional manual methods of disease and pest identification.[11]

Ruchi Rani, Jayakrushna Sahoo, Sivaiah Bellamkonda, Sumit Kumar, “Role of Artificial Intelligence in Agriculture: An Analysis and Advancements with Focus on Plant Diseases”, IEEE Access 2023. This paper presents a comprehensive multi-faceted survey and analysis of recent AI techniques aimed at combating plant diseases. It explores the challenges farmers encounter and how AI-driven solutions can help overcome them. Additionally, it reviews various AI applications in agriculture, highlighting current trends and innovations such as Identification Model Improvement (IMI), Few-Shot Learning (FSL), Generative Adversarial Networks (GANs), and Self-Supervised Learning (SSL). The article also discusses key challenges in implementing AI for plant disease detection. This survey serves as a valuable resource for researchers seeking to advance AI applications in agriculture and address farmers’ pressing issues.[12]

Pallepati Vasavi, Arumugam Punitha, T. Venkat Narayana Rao, “Crop leaf disease detection and classification using machine learning and deep learning algorithms by visual symptoms: a review”, International Journal of Electrical and Computer Engineering 2022. This paper provides a comprehensive overview of recent research on crop leaf disease prediction using image processing (IP), machine learning (ML), and deep learning (DL) techniques. These approaches have achieved remarkable accuracy in identifying diseases. We survey various studies, analyzing them based on dataset size, number of images, disease classes, algorithms employed, convolutional neural network (CNN) models used, and overall performance. Based on this analysis, we offer recommendations on the most suitable algorithms for deployment across different platforms, including standard computers, mobile and embedded systems, drones, robots, and unmanned aerial vehicles (UAVs).[13]

Vaishnavi Monigari, G. Khyathi Sri, T. Prathima, “Plant Leaf Disease Prediction”, International Journal for Research in Applied Science & Engineering Technology (IJRASET)2021. Agriculture plays a vital role in the Indian economy, and plant diseases pose a serious threat by causing significant losses in crop yield, quality, and economic value. Early and accurate detection of plant diseases is essential to prevent these losses and ensure sustainable agricultural productivity. Monitoring large crop areas manually is both labor-intensive and requires specialized expertise, making it impractical at scale. To address this, image processing techniques have become an effective approach for plant disease detection. These techniques involve stages such as image acquisition, filtering, segmentation, feature extraction, and classification, enabling timely and efficient identification of diseases to support better crop management.[14]

Ersin Elbasi, Chamseddine Zaki, Ahmet E. Topcu, Wiem Abdelbaki, Aymen I. Zreikat , Elda Cina, Ahmed Shdefat and Louai Saker, “Crop Prediction Model Using Machine Learning Algorithms”, Appl. Sci. 2023.

This research explores the potential benefits of integrating machine learning algorithms into modern agriculture to optimize crop production and reduce waste through informed decisions about planting, watering, and harvesting. The paper reviews the current state of machine learning applications in agriculture, discusses key challenges and opportunities, and presents experimental results demonstrating how label changes affect the accuracy of data analysis algorithms. By analyzing diverse farm data—including real-time online IoT sensor inputs—farmers can make better decisions that influence crop growth positively. We evaluated fifteen different algorithms to identify the most suitable ones for agricultural applications and proposed a new feature combination-enhanced algorithm. Our results show classification accuracies of up to 99.59% with the Bayes Net algorithm and 99.46% with Naïve Bayes and Hoeffding Tree classifiers. These findings suggest that integrating machine learning can boost crop yields, reduce farming costs, and promote more resilient and sustainable agricultural systems. Ultimately, this study's insights can help farmers detect diseases early, improve crop efficiency, and alleviate food shortages worldwide.[15]

METHODOLOGY

The first step is to collect images of different crops, including both healthy and diseased leaves. These images are gathered from trusted agricultural datasets and real farm samples. Having a large and diverse dataset helps the system learn to recognize diseases more accurately.

Once the images are collected, they are cleaned and prepared for training. This involves resizing the images, removing noise, and sometimes enhancing the colors to make disease patterns more visible. Preprocessing ensures that the images are consistent and ready to be used by the CNN model.

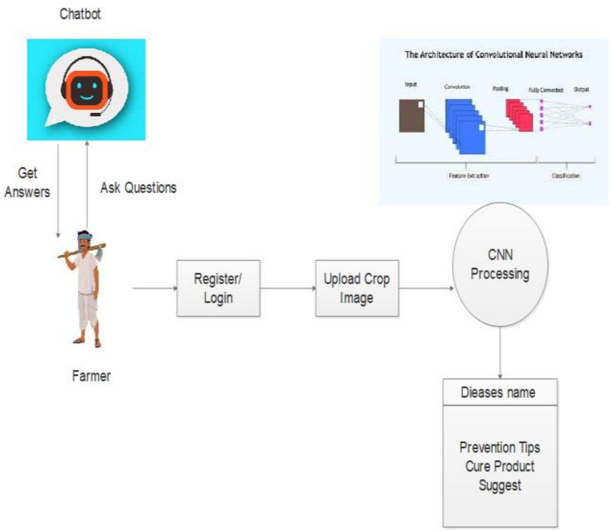
In this step, a Convolutional Neural Network (CNN) model is used to train the system. The CNN automatically learns important features of the crops, such as spots, patches, or discoloration, which are signs of diseases. The model is trained with many images so it can identify patterns and classify crops into categories like "healthy" or "diseased."

After training, the system is ready to predict diseases. Farmers upload an image of their crop leaf, and the trained CNN model analyzes it. The system then predicts whether the crop is healthy or affected by a specific disease.

Along with detection, the system provides practical solutions. It shows precautionary steps that farmers can take to prevent the disease from spreading. It also suggests suitable products, like fertilizers or pesticides, to help control the problem effectively.

To make the system farmer-friendly, a chatbot is included. Farmers can ask questions about crop diseases, remedies, or general farming practices in simple language. The chatbot provides instant answers, acting like a virtual assistant for farmers.

SYSTEM ARCHITECTURE



OBJECTIVE

1. To develop a system that can detect crop diseases accurately using images and a CNN model.
2. To provide farmers with clear information about the detected disease, including symptoms and precautions.
3. To suggest suitable products to control or prevent the disease.
4. To create an interactive chatbot that answers farmers' questions about crops and farming practices.

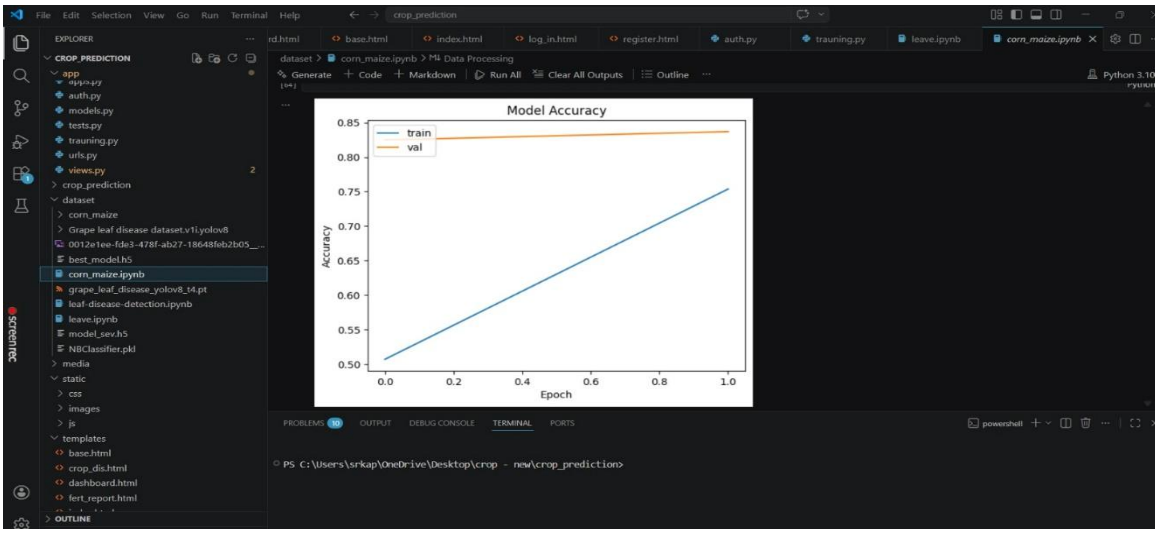
PROBLEM DEFINATIONS

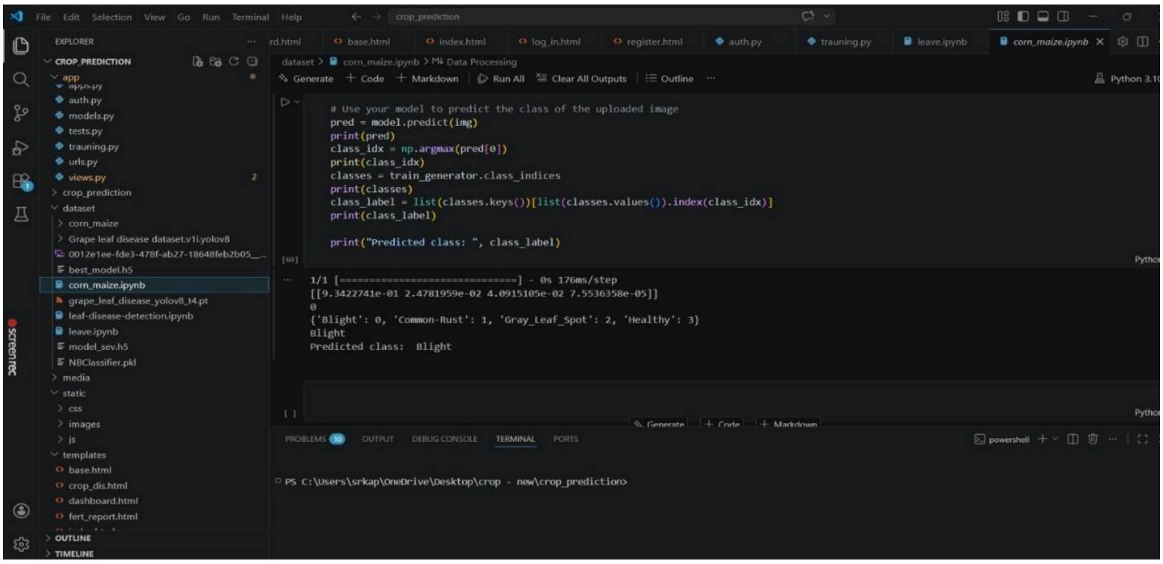
Farmers often face serious problems when crops get infected with diseases. Identifying these diseases early is difficult because it requires expert knowledge and constant monitoring. Many farmers rely on guesswork or expensive expert visits, which can lead to delays in treatment. This delay can cause large losses in crop yield and income.

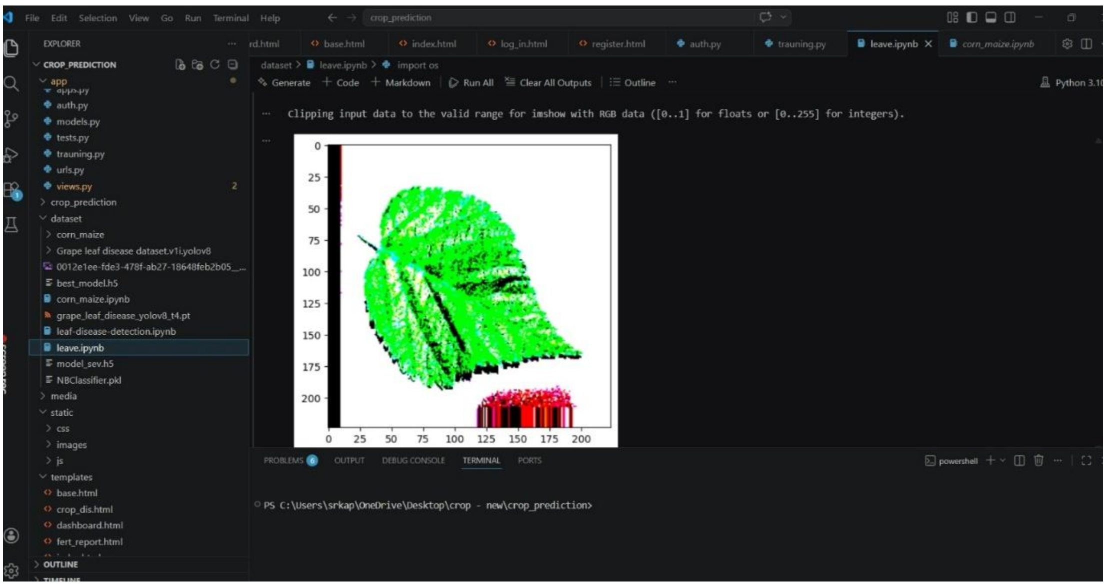
There is a need for an easy, fast, and reliable solution that can help farmers detect crop diseases at an early stage. The solution should be simple to use, even for farmers with little technical knowledge, and should provide not only disease detection but also guidance on how to treat it.

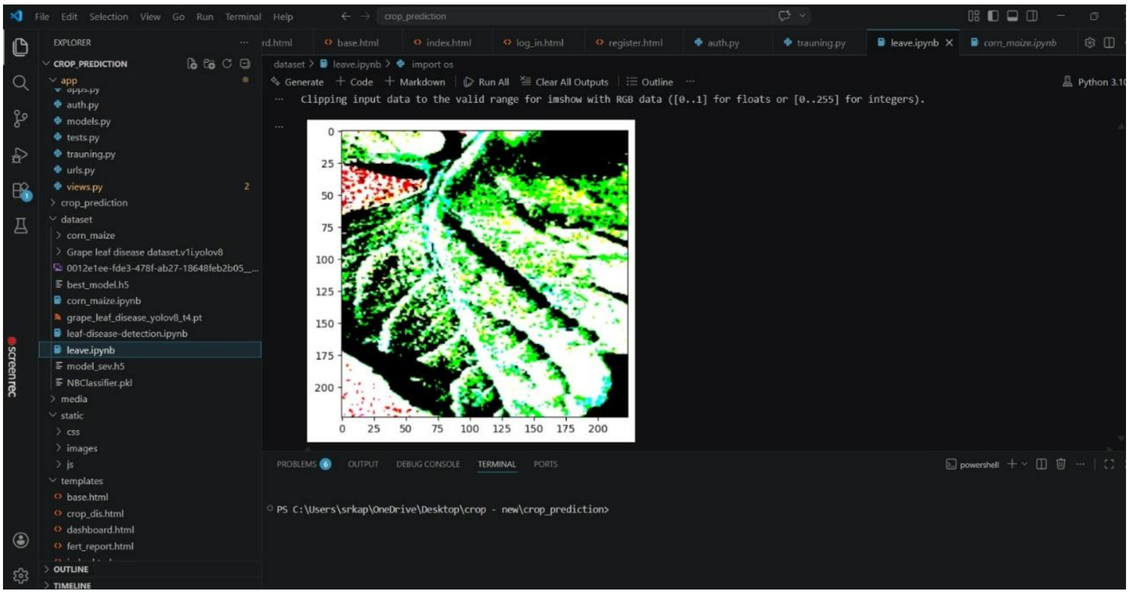
Our project addresses this problem by developing a smart system that uses a CNN model to detect diseases from crop images and provides farmers with precautionary advice and product recommendations. Additionally, the system includes a chatbot to answer farmers' questions instantly, making disease management faster and more accessible.

RESULTS


Model Accuracy
train
val
Accuracy
Epoch
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.0
0.2
0.4
0.6
0.8
1.0
PS C:\Users\srkap\OneDrive\Desktop\crop - new\crop_prediction>


# Use your model to predict the class of the uploaded image
pred = model.predict(img)
print(pred)
class_idx = np.argmax(pred[0])
print(class_idx)
classes = train_generator.class_indices
print(classes)
class_label = list(classes.keys())[list(classes.values()).index(class_idx)]
print(class_label)
print("Predicted class: ", class_label)
1/1 [==============================] - 0s 176ms/step
[[9.3422741e-01 2.4781959e-02 4.0915105e-02 7.5536358e-05]]
0
{'Blight': 0, 'Common-Rust': 1, 'Gray_Leaf_Spot': 2, 'Healthy': 3}
Blight
Predicted class: Blight
PS C:\Users\srkap\OneDrive\Desktop\crop - new\crop_prediction>


Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).
PS C:\Users\srkap\OneDrive\Desktop\crop - new\crop_prediction>



CONCLUSION

In conclusion, this system will make farming easier and more efficient for farmers. By using deep learning and a CNN model, it can quickly identify crop diseases from images, helping farmers take action before the problem spreads. The integrated chatbot makes the system even more useful by giving instant advice in simple language. Overall, this solution will save time, reduce crop losses, and support farmers in growing healthier crops.

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