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CROP DISEASE IDENTIFICATION AND FERTILIZER RECOMMENDATION SYSTEM

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ABSTRACT

Agriculture is rapidly evolving with the integration of Machine Learning (ML) and Artificial Intelligence (AI) technologies. This project introduces a web-based platform using the MERN stack, along with Convolutional Neural Networks (CNN) and Natural Language Processing (NLP) algorithms, to offer farmers precise fertilizer recommendations and crop disease detection. The system processes both text and image inputs, identifying crop diseases using CNN for image processing and NLP for text-based symptom descriptions. Once diagnosed, the system suggests optimal fertilizer use based on crop conditions and soil types. Email API integration facilitates real-time notifications for timely recommendations. By leveraging AI/ML, this application aims to enhance agricultural productivity, reduce resource wastage, and promote sustainable farming practices.

Keywords: MERN Stack, Convolutional Neural Networks, Natural Language Processing, Fertilizer Recommendation, Crop Disease Detection, AI In Agriculture, Sustainable Farming, Web Application.

I. INTRODUCTION

The agricultural sector is one of the most crucial pillars of the global economy, yet it faces numerous challenges such as crop diseases, inefficient fertilizer use, and inconsistent weather conditions. To address these issues, technological innovations in AI and ML offer promising solutions. This project focuses on developing a web-based application that helps farmers make informed decisions through disease detection and fertilizer recommendations. Built on the MERN stack, the application processes both image and text inputs, using CNN for plant disease identification and NLP for analyzing textual data. The platform provides personalized fertilizer recommendations, tailored to the specific needs of the crop and soil type, thereby optimizing fertilizer use. Additionally, it enables community building among farmers by offering location-based alerts and interaction tools. The significance of this project lies in its ability to reduce resource wastage and improve crop yields. Traditional agricultural methods often rely on general-purpose fertilizer use, which may not suit the unique conditions of every farm. By providing a customized solution based on AI-driven models, this platform empowers farmers to make precise decisions. Furthermore, the integration of Email API ensures that farmers receive timely updates on crop health and fertilizer recommendations, enhancing the overall effectiveness of farming practices.

II. LITERATURE SURVEY

Numerous studies have explored the integration of AI/ML techniques in agriculture, with a primary focus on plant disease detection and yield optimization. For instance, research by Nilam Bhise et al. (2020) highlights the use of image processing techniques for plant disease identification, demonstrating how early detection can prevent yield loss. Nishant Shelar et al. (2022) emphasize the application of CNNs in plant disease detection, particularly in scenarios involving complex disease patterns. Meanwhile, studies like that of Devdatta Bondre (2019) focus on crop yield prediction and fertilizer recommendation using algorithms such as Support Vector Machines (SVM) and Random Forest. These studies highlight the critical role of accurate diagnosis in preventing losses and improving productivity. Despite the progress in plant disease detection, the literature indicates gaps in the integration of fertilizer recommendation systems based on disease diagnostics. For example, Shreya Patil et al. (2022) present a CNN-based model for plant leaf disease detection but lack

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integrated fertilizer recommendations based on the results. Similarly, while Muhammad Shoaib et al. (2023) discuss advanced deep learning models for early plant disease detection, the studies do not address how such detections can guide fertilizer use. This gap emphasizes the need for a unified system that not only detects diseases but also recommends appropriate fertilizers based on diagnostic outcomes, bridging the gap between disease identification and crop treatment.

Title	Author	Year/Journal name	Summary
[1]-Plant Disease Detection using Machine Learning	Ms. Nilam Bhise1, Ms. Shreya Kathet2, Mast. Sagar Jaiswar3, Prof. Amarja Adgaonkar4	2020 IRJET	The paper focuses on disease identification in plants using image processing techniques, showcasing the significance of accurate detection for preventing crop yield loss.
[2]- Plant Disease Detection	Nishant Shelar1 , Suraj Shinde2 , ShubhamSawant3 , Shreyash Dhumal4 , and Kausar Fakir	2022 ICACC	They Detect Diseases by applying CNN(Convolution Neural Network)
[3] - Plant Disease Detection Using Deep Learning	Kowshik B1, Savitha V2, Nimosh madhav M3,Karpagam G4, Sangeetha K5	2021 IRJASH	The article proposes a Deep Learning-based strategy to detect crop diseases and aiming to improve agricultural productivity.
[4]- Prediction Of crop Yield and fertilizer recommendation using ML	Devdatta A. Bondre ,Mr. Santosh Mahagaonkar	2019 IJEAST	the paper predicts crop yield and recommends fertilizers based on algorithms like SVM and Random Forest.
[5]-PLANT LEAF DISEASE DETECTION USING CONVOLUTION NEURAL NETWORK	Shreya Patil, Soukhya L Deshpande, Soumya Sumbad, Soumya S Kiranagi	2022 IJCRT	The paper presents a Deep CNN-based solution for swift and precise plant disease detection, addressing global farming challenges
[6]-Wheat disease detection using SVM classifier.	Er.Varinderjit Kaur , Dr.Ashish Oberoi	2018 JETIR	The paper surveys the application of SVM Classifier techniques for the accurate detection and classification of wheat diseases from visible spectrum images.

III. METHODOLOGY

Currently, most agricultural systems focus on either disease detection or fertilizer recommendations, but not both in tandem. Existing platforms for crop disease detection, such as those using CNN models, are primarily designed to analyze images of diseased plants and classify the type of disease. For example, applications that rely on deep learning models such as VGG16 or MobileNet focus on accurately diagnosing crop diseases through image recognition but fail to provide actionable insights regarding treatment.

Similarly, fertilizer recommendation systems often rely on static, generalized advice based on crop type or soil condition. These systems, while useful, do not account for real-time disease detection or offer personalized recommendations that align with the current health of the plant. Moreover, many existing solutions lack user-friendly interfaces, real-time notifications, and fail to provide a holistic view of a farmer's requirements, such as weather conditions and location-based recommendations.

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Paper Name	Algorithm used	location-based alerts	Fertilizer Rrecommendation	Weather forecasting
Plant Disease Detection using Machine Learning	CNN (convolutional neural network)	NO	NO	NO
Plant Disease Detection	CNN (convolutional neural network)	NO	NO	NO
Plant Disease Detection Using Deep Learning	Deep Learning CNN,DNN	NO	NO	NO
Prediction Of crop Yield and fertilizer recommendation	SVM Random Forest	NO	YES	NO
Plant leaf disease detection using Convolution Neural Network.	MobileNet model,VGG16, a type of CNN	NO	gives the remedies for the diseases.	NO
Wheat disease detection using SVM classifier.	SVM, PCA	NO	NO	NO

IV. MODELING AND ANALYSIS

1. PROPOSED SYSTEM

The proposed system integrates both Convolutional Neural Networks (CNN) for image-based plant disease detection and Natural Language Processing (NLP) for analyzing textual descriptions of disease symptoms. The system is built using the MERN stack, ensuring a responsive and scalable web application. CNN processes images uploaded by farmers, identifying the specific disease affecting the crops. Simultaneously, farmers can describe symptoms in text, and the system uses NLP algorithms to provide an accurate diagnosis. Once the disease is identified, the system recommends fertilizers tailored to the specific crop and soil conditions, ensuring optimal nutrient management. The system also includes an Email API for real-time notifications, ensuring farmers are promptly informed of disease outbreaks and necessary treatments. Location-based alerts are another feature of the system, connecting farmers in neighboring regions to collaborate and share insights. The platform is designed with scalability in mind, allowing for future expansion to include more crops, regions, and additional predictive models for weather and pest management. This proposed solution bridges the gap between disease identification and fertilizer use, offering a comprehensive platform that addresses multiple agricultural challenges. The combination of CNN for image processing and NLP for text analysis ensures a high degree of accuracy in disease detection, while the personalized fertilizer recommendation system optimizes crop treatment.

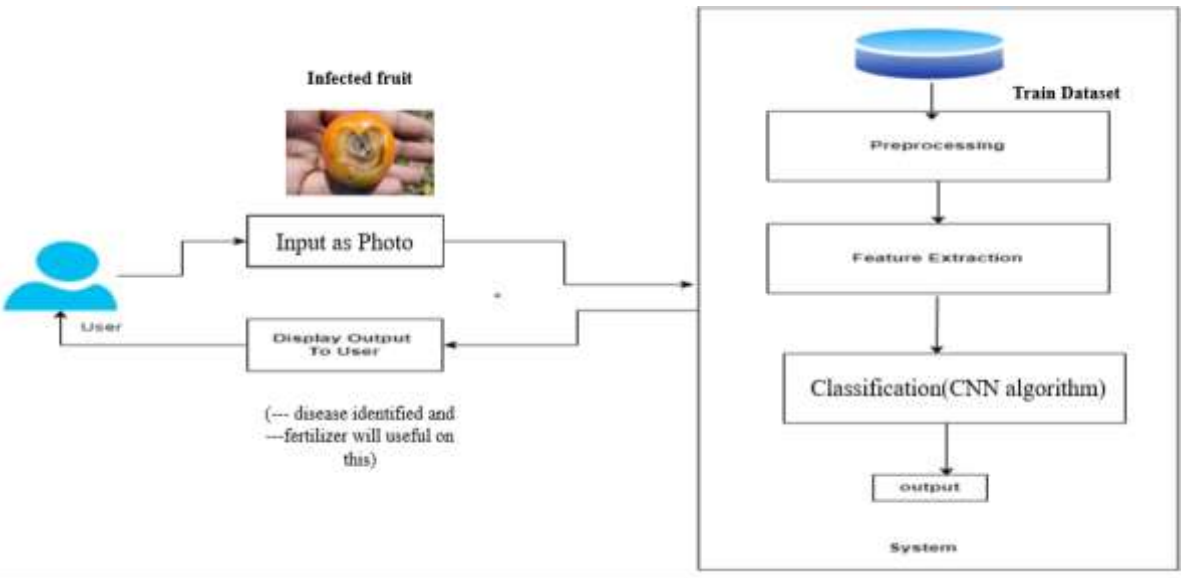

Figure 1:

V. CONCLUSION

The integration of advanced AI/ML algorithms into agriculture holds immense potential for transforming farming practices. By providing a unified platform that detects plant diseases and offers personalized fertilizer recommendations, this project addresses key challenges in modern agriculture. The use of the MERN stack, CNN, and NLP ensures that the system is both scalable and responsive to the evolving needs of farmers. Real-time notifications and community engagement features further enhance the system's usability, making it an invaluable tool for promoting sustainable farming practices. Future iterations of the platform could expand to include real-time weather forecasting, pest management, and multi-language support to cater to a broader audience. By continuously refining the system and incorporating feedback from farmers, this web application has the potential to become a comprehensive solution for modern agricultural challenges, ultimately improving productivity, reducing wastage, and fostering a more sustainable farming ecosystem.

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