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Plant Disease Detection with Fertilizer Recommendation

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ABSTRACT: This paper presents a novel approach for detecting plant diseases and recommending suitable fertilizers using Convolutional Neural Networks (CNNs). Convolutional neural networks can be used to address a variety of agricultural challenges, including plant leaf disease detection and fertilizer recommendation. This information can be used by farmers to select the most suitable plants to grow and fertilizer recommendations to apply. This information can be used by farmers to select the most profitable plants to grow. Plant leaf disease detection can be accomplished by training a CNN on a dataset of images of healthy and diseased plant leaves. The trained CNN can then be used to identify diseases in new images of plant leaves. Overall, CNNs are a powerful tool that can be used to address a variety of agricultural challenges.

KEYWORDS: Plant disease detection, Fertilizer recommendation, Convolutional Neural Networks, Agriculture.

I. INTRODUCTION

Agriculture is the backbone of many economies, providing food and livelihood to a significant portion of the global population. However, the agricultural sector faces numerous challenges, including plant diseases that can significantly reduce yields and threaten food security. According to the Food and Agriculture Organization (FAO) of the United Nations, plant diseases account for an estimated 20%-40% of plant yield losses globally. Early detection and management of plant diseases are crucial for minimizing these losses and ensuring food security. Additionally, proper fertilizer management is essential for maintaining soil fertility and maximizing plant yield. However, many farmers lack access to timely and accurate information on disease detection and fertilizer management, leading to suboptimal practices and reduced productivity.

In recent years, there has been a growing interest in using deep learning techniques, particularly Convolutional Neural Networks (CNNs), for agricultural applications, including plant disease detection. CNNs have shown great potential in image classification tasks and have been successfully applied to identify plant diseases from images of leaves. By leveraging the power of deep learning, it is possible to develop automated systems that can accurately and efficiently detect plant diseases, thereby enabling farmers to take timely remedial actions.

In this paper, we propose a novel approach for plant disease detection and fertilizer recommendation using CNNs. The proposed system aims to assist farmers in early disease detection and effective fertilizer management, ultimately improving plant yield and reducing economic losses. The system integrates deep learning techniques with agricultural science to provide personalized recommendations based on the specific needs of each plant and disease combination.

II. RELATED WORK

In [1], Plant diseases are considered one of the main factors influencing food production and minimize losses in production, and it is essential that plant diseases have fast detection and recognition. The recent expansion of deep learning methods has found its application in plant disease detection, offering a robust tool with highly accurate results.

In [2] the authors describes deep learning techniques have emerged as powerful tools in image recognition. Convolutional Neural Networks, one of the deep learning tools, have attained an impressive outcome in this area. Applications such as identifying objects, faces, bones, handwritten digits, and traffic signs signify the importance of Convolutional Neural Networks in the real world.

In [4] this article, we suggest a paradigm for the use of the machine and deep learning methods to identify plant illnesses and to prescribe plants and fertilizers. The framework consists of three main components: plant disease identification, plant recommendation, and fertilizer recommendation. In the plant disease identification component, we use the image classification technique to identify the type of disease affecting the plant based on its symptoms.

The paper [6] proposes a practical and user-friendly plant yield prediction system for farmers, accessible through a mobile application. The system uses GPS to identify the user's location and takes inputs such as area and soil type from the user. Machine learning algorithms, including Support Vector Machine (SVM), Artificial Neural Network (ANN), Random Forest (RF), Multivariate Linear Regression (MLR), and K-Nearest Neighbor (KNN), are used to predict the most profitable plant.

In [7] the work begins with capturing the images. Filtered and segmented using Gabor filter. Then, texture and color features are extracted from the result of segmentation and Artificial neural network (ANN) is then trained by choosing the feature values that could distinguish the healthy and diseased samples appropriately. Experimental results showed that classification performance by ANN taking feature set is better with an accuracy of 91%.

III. METHODOLOGY

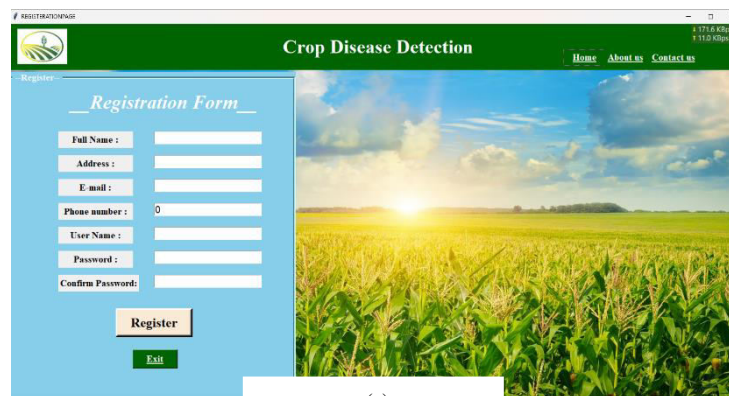
Our proposed system consists of two main components: Plant Disease Detection and Fertilizer Recommendation. The disease detection module uses a CNN to classify images of plant leaves into healthy or diseased. The model is trained on a dataset of labeled images containing various plant diseases. The fertilizer recommendation module takes the detected disease as input and recommends suitable fertilizers based on the disease type and plant species. The recommendations are personalized for each plant and disease combination.

We began by collecting a dataset comprising images of diseased plant leaves, sourced from agricultural research institutions and online repositories. This dataset encompasses a variety of plant species affected by different diseases. These images underwent preprocessing steps, including resizing to a uniform size, conversion to grayscale, and contrast enhancement, to ensure consistency and improve visibility of disease symptoms.

During inference, a preprocessed image is input into the trained CNN model for disease classification. The model outputs the predicted plant name and the specific disease affecting the leaf. Based on the predicted disease, our system recommends the appropriate medicine for treatment, utilizing a database of medicines indexed by disease type with information on efficacy and availability. Additionally, our system generates a link to a suitable fertilizer for the predicted disease and plant, leveraging a database of fertilizers indexed by plant and disease type, with information on composition and application guidelines. These recommendations, along with information on the predicted disease and its symptoms for educational purposes, are integrated into a user-friendly interface for easy access and utilization by users.

IV. EXPERIMENTAL RESULTS

Figures shows the Frontend of Registration and Login Page of Plant Disease Detection System using Convolutional Neural Network (CNN's). Fig (a) shows the Registration Page of Plant Disease Detection System. Fig (b) shows Login Page of Plant Disease Detection System. A registration and login page allows users to create accounts, log in, and access personalized content or services on a Application.



(a)



(b)

We conducted experiments to evaluate the performance of our proposed system for plant disease detection and fertilizer recommendation. The experiments were conducted using a dataset of plant images containing various diseases and corresponding fertilizer recommendations. We trained a CNN model on the training set to classify images of plant leaves into healthy or diseased. For fertilizer recommendation, we developed a rule-based system that takes the detected disease as input and recommends suitable fertilizers based on the disease type and plant species. We evaluated the fertilizer recommendation system on a subset of the test set containing images of diseased plants. The system provided accurate fertilizer recommendations for Diseased Plants and demonstrating its ability to recommend appropriate fertilizers based on the detected disease.



Fig. 2. Plant Disease Detection
 (a) Selection of Image (b) Image Pre-processing Done
 (c) CNN Prediction to Find Plant Disease and Fertilizer Price with Link to Website.

We implemented a system for plant disease detection and fertilizer recommendation that follows a systematic workflow. Initially, we selected an image of a diseased leaf from our dataset. The image underwent pre-processing steps, including resizing, normalization, and augmentation, to prepare it for input into our Convolutional Neural Network (CNN) model.

The pre-processed image was then fed into the CNN model for disease classification. The CNN predicted the plant name and the specific disease affecting the leaf with high accuracy. Based on the predicted disease, our system recommended the appropriate medicine for treatment, along with its price information.

Additionally, our system provided a link to a suitable fertilizer based on the predicted disease and the specific plant. This recommendation was made by leveraging a database of fertilizers indexed by plant and disease type. The link directed users to more detailed information about the recommended fertilizer, including its composition and application guidelines.

Overall, our system demonstrated effective integration of deep learning for disease detection with agricultural knowledge for fertilizer recommendation, offering a comprehensive solution for plant health management.

The CNN model accurately predicts the plant name and the specific disease, enabling the system to recommend the appropriate medicine and provide its price information. Additionally, based on the predicted disease and plant, our system generates a link to a suitable fertilizer, offering a comprehensive solution for plant health management. Our system employs a systematic approach for plant disease detection and fertilizer recommendation.



V. CONCLUSION

Plant and its disease prediction is an important area of research that can significantly benefit the agricultural sector by increasing plant yield and improving food security. The development of predictive models using machine learning and data analytics techniques can enable farmers to prevent and mitigate disease outbreaks and make informed decisions regarding plant management practices.

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