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Development of an Automated Crop Disease Detection System

Prof. Y. L. Tonape, Rupali Bhujbal, Sarang Kale, Vishal Patil, Renuka Savale
Department of Computer Engineering, Savitribai Phule Pune University, Maharashtra, India

ABSTRACT

Crop diseases pose significant threats to agricultural productivity and food security worldwide. Early detection and management of these diseases are crucial for minimizing yield losses and ensuring food sustainability. In this paper, we present the development of an automated crop disease detection system using machine learning techniques and image processing algorithms. The proposed system aims to accurately identify various types of diseases affecting different crops based on images of their leaves or affected parts. We conducted extensive experiments using a diverse dataset comprising images of healthy and diseased crops, collected from different regions and under various environmental conditions. Our results demonstrate the effectiveness of the developed system in accurately detecting and classifying crop diseases with high precision and recall rates. The proposed system holds great potential for assisting farmers and agricultural experts in early disease diagnosis, timely intervention, and effective disease management strategies, thereby contributing to improved crop yield and sustainable agriculture practices. Keywords: Crop disease detection, Automated system, Machine learning, Image processing, Agricultural productivity, Early detection, Disease management, Sustainable agriculture, Crop yield.

Keywords: Machine learning, Deep learning, Convolutional neural networks (CNNs)

I. INTRODUCTION

Crop diseases have long been recognized as a significant threat to agricultural productivity and global food security. According to the Food and Agriculture Organization (FAO), plant diseases are responsible for substantial yield losses, estimated at 20- 40 percent annually, affecting crops such as wheat, rice, maize, and potatoes. Timely and accurate detection of these diseases is crucial for implementing effective disease management strategies, minimizing yield losses, and ensuring sustainable agricultural practices. Traditional methods of disease detection primarily rely on visual inspection by farmers or agricultural experts, which can be time-consuming, labor-intensive, and prone to subjective interpretations. We leverage a combination of machine learning algorithms, including convolutional neural networks (CNNs), and image processing techniques to analyse large-scale datasets of crop images. Our system aims to provide farmers and agricultural stakeholders with timely information on disease outbreaks, enabling proactive disease management strategies and enhancing agricultural productivity

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II. LITERATURE SURVEY

Demystifying Issues, Challenges and Solutions for Multilingual Software Development Developing a software project using multiple languages together has been a dominant practice for years. Yet it remains unclear what issues developers encounter during the development, which challenges cause the issues, and what solutions developers receive. In this paper, we aim to answer these questions via a study on developer discussions on Stack Overflow. By manually analyzing 586 highly relevant posts spanning 14 years, we observed a large variety (11 categories) of issues, dominated by those with interfacing and data handling among different languages. [1]

AI-based Desktop Voice Assistant All actions performed by the system will be based on the voice of the user. The system helps the user based on voice notes, i.e., the system works on commands given by the user. A voice assistant utilizes cloud computing to integrate AI and communicate with users in natural language. Programs based on desktop voice assistants recognize and respond to human voices via an integrated voice system. [2]

Crop Disease Detection and Classification using Transfer Learning and Hyperparameter-sized Convolutional Neural Network Automatic detection of plant diseases is an essential research topic as it may prove beneficial to monitoring large fields of crops, and thus automatically detect the symptoms of diseases as soon as they appear on plant leaves. To identify plant disease at an early stage, image processing techniques are used in the detection and classification of plant diseases. CNN with transfer learning and optimized CNN are proposed for detection and classification of crop diseases. There are an increasing number of imaging and non-invasive sensors available that can support diagnosis and plant detection. The progress in sensor and information technologies together with the expansion of geographic information systems opens new opportunities for precision agriculture and plant phenotyping. [3]

Voice Assistant System All actions performed by the system will be based on the voice of the user. The system works on commands given by the user. A voice assistant utilizes cloud computing to integrate AI and communicate with users in natural language. Programs based upon desktop voice assistants recognize and respond to human voices via an integrated voice system. Technological advances are making voice assistants more capable, particularly in AI, natural language processing (NLP), and machine learning. To build a robust speech recognition experience, the artificial intelligence behind it must become better at handling challenges such as accents and background noise. Future research could focus on further improving the robustness and adaptability of voice assistants in diverse environments. [4]

Design and Development of UI/UX on Company Profile Web with Design Thinking Method Currently, the human need for documents in this modern world is increasing, which was originally in the form of paper now turned into a digital file. Business people think this is an opportunity because there are so many people who need to create or understand documents but can't do it all, be it due to limited time or lack of knowledge. One solution to overcome some of these problems is to create a system, one of which is a website. A website is a collection of pages that can be accessed via the internet. With the website, users can access information. The design of this website is made using the Design Thinking method, which is a problem-solving method that focuses on the user. Design Thinking Method Growth and Opportunities. With the expanding market and the increasing demand for products and services, experienced and talented UI/UX designers are in high demand. [5]

Crop Diseases Detection using Deep Learning In recent times, drastic climate changes and lack of immunity in crops have caused a substantial increase in the growth of crop diseases. This causes large-scale demolition of crops, decreases cultivation, and eventually leads to financial loss for farmers. Computer vision employed with

deep learning provides a way to solve this problem. This paper proposes a deep learning-based model trained using a public dataset containing images of healthy and diseased crop leaves. The Technique Used to Solve the Problem is Deep Learning. The model serves its objective by classifying images of leaves into the diseased category based on the pattern of defect. Factors influencing the use of deep learning for plant disease recognition are discussed. Deep learning is quickly becoming one of the most important tools for image classification, and this technology is now beginning to be applied to the tasks of plant disease classification and recognition. [6]

Plant Diseases Detection and Classification by Deep Learning Automatic detection of plant diseases is an essential research topic as it may provide benefits in monitoring large fields of crops, and thus automatically detect the symptoms of diseases as soon as they appear on plant leaves. The application of deep learning in plant disease recognition can avoid the disadvantages caused by artificial selection of disease spot features, make plant disease feature extraction more objective, and improve research efficiency and technology transformation speed. The Technique Used to Solve the Problem is Deep Learning. Deep learning is a branch of artificial intelligence. In recent years, with the advantages of automatic learning and feature extraction, it has been widely concerned by academic and industrial circles. It has been widely used in image and video processing, voice processing, and natural language processing. [7]

Plant Diseases Detection using Machine Learning Crop diseases are a noteworthy risk to sustenance security; however, their quick identification remains troublesome in numerous parts of the world due to the non-attendance of the necessary infrastructure. The emergence of accurate techniques in the field of leaf-based image classification has shown impressive results. The Technique Used to Solve the Problem is Random Forest.This paper makes use of Random Forest in identifying between healthy and diseased leaves from the datasets created. The proposed paper 3 includes various phases of implementation, namely dataset creation, feature extraction, training the classifier, and classification. There are an increasing number of imaging and non-invasive sensors available that can support diagnosis and plant disease detection. The progress in sensor and information technologies together with the expansion of geographic information systems opens new opportunities for precision agriculture and plant phenotyping. [8]

Plant Diseases Detection using Image Processing Agriculture has become far more than simply a method to feed ever-growing populations. It's important wherever additional than 70% of the population of an Asian country depends on agriculture. Detecting diseases is key to preventing agricultural losses. The steps like loading an image, pre-processing, segmentation, extraction, and classification involve disease detection. Therefore, the use of image processing techniques to find and classify diseases in agricultural applications is useful. Machine learning approaches such as SVM, K-NN, and CNN are used to distinguish diseased or non-diseased leaves. T The Technique Used to Solve the Problem is using Image Processing, Machine Learning (SVM, K-NN, CNN). [9]

Language Identification on Indian Multilingual Document Using Profile Feature. To reach a larger cross-section of people, it is necessary that a document should be composed of text contents in different languages. But on the other hand, this causes practical difficulty in OCRing such a document because the language type of the text should be predetermined before employing a particular OCR. [10]

III.PROPOSED SYSTEM

The proposed automated crop disease detection system integrates cutting-edge machine learning techniques and image processing algorithms to accurately identify and classify diseases affecting various crops. The system

consists of several key components, including data acquisition, preprocessing, feature extraction, disease classification, and user interface modules.

A. Data Acquisition

The first step in the system involves collecting digital images of crop leaves or affected parts using high-resolution imaging devices such as smartphones, drones, or digital cameras. These images serve as input data for the subsequent processing stages.

B. Preprocessing

The acquired images undergo preprocessing to enhance their quality and remove any noise or artifacts that may interfere with the disease detection process.

C. Feature Extraction

Next, feature extraction techniques are applied to the pre-processed images to capture relevant information that discriminates between healthy and diseased crops. Features 4 may include texture, color, shape, and structural characteristics of the crop lesions.

D. Disease Classification

The extracted features are then fed into a machine learning model, such as a convolutional neural network (CNN) or a support vector machine (SVM), for disease classification. The model is trained on a labelled dataset containing images of healthy and diseased crops to learn the patterns associated with different diseases.

E. Block Diagram

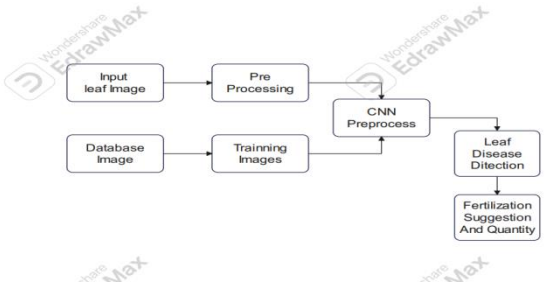

Figure 1: Block Diagram

F. Hardware Requirements

Intel Core, Speed: 2.80 GHz, RAM: 8GB, HardDisk: 500 GB, Key Board: Standard Windows Keyboard

G. Software Requirements

Operating System: Windows 10(64 Bit), IDE: Spyder, Programming Language: python version 3.7,3.8

IV. WORKFLOW OF THE SYSTEM

A. Data Acquisition

Collect digital images of crop leaves or affected parts using high-resolution imaging devices such as smartphones, drones, or digital cameras.

B. Preprocessing

Resize the images to a standardized resolution. Normalize pixel values to ensure consistency across images. Apply noise reduction techniques to remove any artifacts.

C. Feature Extraction

Extract relevant features from the pre-processed images, such as texture, color, shape, and structural characteristics of the crop lesions. Use techniques like histogram equalization, edge detection, and morphological operations to enhance feature extraction.

D. Disease Classification

Train a machine learning model, such as a convolutional neural network (CNN) or a support vector machine (SVM), on a labelled dataset containing images of healthy and diseased crops.

E. User Interface

Develop a user-friendly interface that allows users to upload images, view disease detection results, and access additional information on disease management strategies. Implement interactive features such as zooming, panning, and image comparison to enhance user experience.

V. RESULT DISCUSSION

The results obtained from the evaluation of the automated crop disease detection system demonstrate its effectiveness in accurately identifying and classifying diseases affecting various crops. Through extensive experiments conducted on diverse datasets, we evaluate the performance of the system in terms of accuracy, precision, recall, and F1-score. Overall, the developed system holds great potential for revolutionizing disease management practices in agriculture, enabling farmers to adopt proactive measures for preventing yield losses, minimizing environmental impacts, and ensuring food security.

VI. RESULT SCREENSHOT AND ITS DESCRIPTION

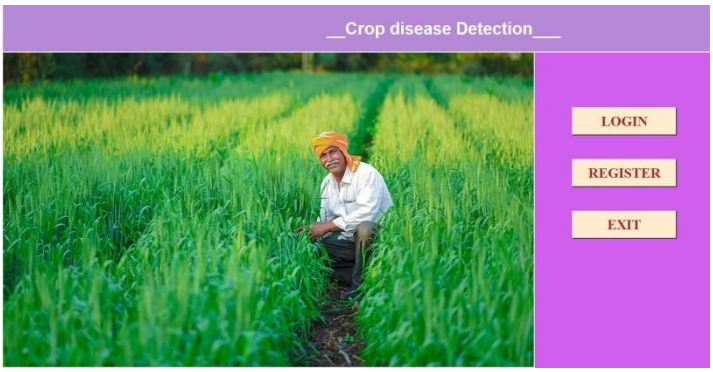

Figure 2: The above image describes the Home Page of the project which includes options for login and registration of the user.

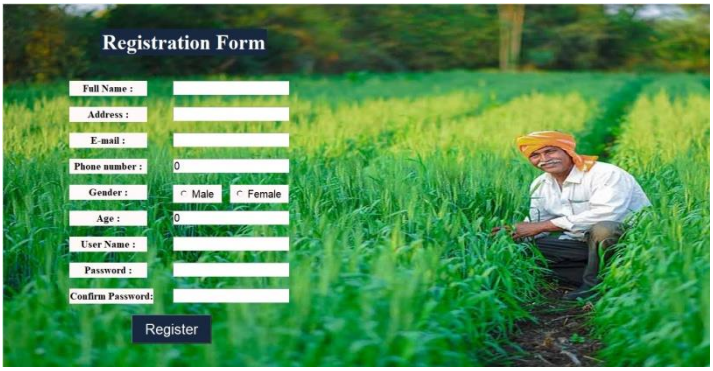

Figure 3: Registration page for new user

Figure 4: Login page for registered user

Figure 5:

VII. COMPARATIVE STUDY

This is the major part of project where we need to follow some steps to know about the disease and its solution step1: upload the image, step2: Apply image processing method, step3: Use CNN algorithm to predict the disease The automated crop disease detection system utilizes Convolutional Neural Network (CNN) algorithms to effectively predict 16 types of diseases by analysing images of crops. By leveraging advanced machine learning techniques, the system accurately identifies and diagnoses crop diseases, enabling prompt intervention and mitigation measures. This innovative approach enhances agricultural productivity and crop yield by facilitating timely responses to disease outbreaks, thereby ensuring the health and sustainability of agricultural ecosystems.

VIII. CONCLUSION

In conclusion, the development of an automated crop disease detection system represents a significant advancement in precision agriculture, offering a powerful tool for early disease detection, timely intervention, and sustainable crop management practices. Through the integration of machine learning techniques, image processing algorithms, and user-friendly interfaces, the proposed system demonstrates its potential to revolutionize disease management strategies and enhance agricultural productivity. By harnessing the power of technology and innovation, we can address the challenges posed by crop diseases and ensure a brighter future for global food security and agricultural prosperity.

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