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A Plant Disease Detection System Using Android App

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Abstract: India, predominantly reliant on agriculture, suffers an estimated 18% loss in global crop yield annually due to pest attacks, amounting to approximately Rs. 90,000 million. Overuse of pesticides poses numerous hazards including soil degradation, acute toxicity to humans and animals, shifts in pest populations, high control costs, and environmental residue issues. Whiteflies are particularly problematic pests, infesting plant leaves, excreting sticky honeydew, causing leaf discoloration or death, and reducing crop yield. Traditionally, farmers have relied on visual assessments to gauge whitefly infestations, but this method is often imprecise due to varying identification skills and the time-consuming nature of laboratory inspections. Given the economic importance of crops and the severe impact of pest damage, early detection of whiteflies has become imperative. To address this, we propose an Android application that calculates the affected area of plants and determines disease severity. The application also provides treatment recommendations in Hindi for identified diseases. Detection of plant diseases is a critical research area, offering benefits in monitoring vast agricultural fields. Automated disease detection through image processing offers a more accurate and efficient alternative to manual visual identification, which is prone to errors and time constraints. This approach enhances accuracy and facilitates timely intervention and disease management, ultimately improving crop productivity and sustainability.

Keywords: : Image Processing, Plant Disease, HSV(Hue Saturation Value), Machine Learning. Android Application

I. INTRODUCTION

India, with its agrarian backbone supporting nearly 70% of its populace, boasts a diverse spectrum of fruit and vegetable crops for cultivation. However, achieving optimal yields and maintaining produce quality necessitates advanced technical know-how. Perennial fruit crop management, particularly in disease control, requires vigilant oversight, given its profound impact on production and post-harvest preservation.In the context of climate change, agriculture has transcended its traditional role, emerging as a crucial player in mitigating environmental challenges. Yet, the looming threat of various diseases jeopardizes agricultural sustainability, posing significant economic, social, and ecological risks. Therefore, accurate and timely disease diagnosis stands as a cornerstone of modern agricultural practices.A plethora of methods exists for detecting plant pathologies, ranging from intricate microscopic analysis to sophisticated remote sensing techniques empowered by digital image processing. However, the complexities inherent in these methods, coupled with extensive literature, warrant a focused discussion beyond the scope of this narrative. Nonetheless, visual symptom observation remains a prevalent approach, albeit constrained by inherent limitations hampering effective disease management.Our research endeavors to bridge this gap by centering on plant disease detection, leveraging cutting-edge edge detection and color matching histogram techniques. Our primary focus lies in optimizing both accuracy and speed in disease identification. By harnessing advancements in color space analysis, histogram computation, and edge detection algorithms, we aim to revolutionize disease identification processes in agricultural settings.The imperative of identifying and managing plant diseases cannot be overstated in ensuring food security and sustaining agricultural productivity. Given the inefficiencies of manual disease monitoring, the adoption of advanced image processing techniques offers a promising pathway forward. Disease detection methodologies encompass a comprehensive array of stages, from image acquisition and preprocessing to segmentation, feature extraction, and classification, all aimed at facilitating efficient disease management practices indispensable for the longevity of agriculture and food production systems.

II. RELATED WORK

Harshal Waghmare et al. [1] introduced a technique for plant disease identification utilizing pattern recognition and leaf texture analysis, with a specific focus on detecting diseases in grape plant leaves. Their system takes individual plant leaves as input, conducts background removal segmentation, applies high-pass filtering for disease detection, and analyzes leaf texture using fractal-based features. Employing Multiclass Support Vector Machine (SVM) classification, the

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proposed approach achieves a commendable accuracy of 96.6%, offering practical advice from agricultural experts to farmers.

Jitesh P. Shah et al. [2] conducted a comprehensive survey of various techniques, emphasizing concepts from Image Processing and Machine Learning for plant disease detection. Their study primarily targets the detection of three rice diseases: bacterial leaf blight, brown spot, and leaf smut. They propose the design of an automated system utilizing communication technologies and computer systems to provide early disease notifications.

Shivani P. Tichkule et al. [3] utilized K-means clustering for detecting infected plants and Neural Networks to enhance accuracy in disease detection and classification. Additionally, they explore the Agrobot technique for plant disease detection, an agricultural robot capable of performing various tasks from seeding to pesticide spraying, thereby reducing labor costs and human effort.

E. Borges et al. [4] explored Electric Impedance Spectroscopy (EIS) to identify the electric properties of plant tissue, particularly in verifying fruits and their qualities, temperature effects, and maturation processes. Preliminary tests demonstrate the efficiency of EIS in plant disease detection, offering promising prospects for future applications.

Arti N. Rathod et al. [5] proposed an advanced computing system for disease recognition using infected leaf images. They utilize digital camera mobiles for image capture, employing image processing techniques for disease classification and quantification of affected areas, effectively identifying diseases in various plant parts.

Rajleen Kaur et al. [6] proposed an automatic disease detection system in agricultural crop production utilizing Support Vector Machine (SVM) classifiers. Their approach involves segmenting healthy and diseased plant parts, providing accurate disease identification and classification, thereby enhancing classifier computation in neural networks.

Sachin D. Khirade et al. [7] discussed methods for disease detection using leaf images, emphasizing segmentation and feature extraction algorithms. Their proposed system follows specific steps, including image acquisition, preprocessing, segmentation, feature extraction, and disease detection and classification.

Rajat Kanti Sarkar et al. [8] proposed an automatic seeded region growing (SRG) algorithm for colored plant images, utilizing the Euclidean distance algorithm for computing color differences and a two-dimensional lookup table for region merging, achieving improved segmentation results compared to other techniques.

Rong Zhou et al. [9] presented a hybrid algorithm for robust and early leaf spot detection in bet and sugar plants, combining template matching and Support Vector Machine techniques to achieve effective disease detection under natural conditions.

Zulkii Bin Husin et al. [10] introduced an approach for early detection of chili diseases using leaf feature inspection, providing an efficient and inexpensive method for monitoring large plantation areas.

Sachin Khirade and A. B. Patil [11] outlined the main steps of image processing for plant disease detection and classification, including image acquisition, preprocessing, segmentation, feature extraction, and classification. Their approach incorporates methods like k-means clustering and morphology feature extraction for accurate results.

Bhog and Pawar [12] integrated neural network concepts for cotton leaf disease classification, utilizing K-means clustering for segmentation. Their study addresses various cotton leaf diseases and achieves a recognition accuracy of 89.56% using MATLAB toolbox.

Ms. Kiran R. Gavhale et al. [13] presented multiple image processing techniques for extracting diseased parts of leaves, including DCT domain-based image enhancement, k-means clustering for segmentation, and GLCM matrix-based feature extraction. Their study focuses on classifying canker and anthracnose diseases of citrus leaves using SVM with radial basis and polynomial kernels.

III. MOTIVATION AND OBJECTIVE

Motivation: Acknowledging the vital role of farmers as the backbone of India, and recognizing the critical issues associated with plant diseases, the development of a system model for leaf disease detection in agriculture wasinspired by the need to facilitate agricultural development in India through user-friendly applications.

Objectives: The objectives are outlined as follows: Develop a cost-efficient application. Optimize the utilization of image processing techniques. Provide a solution with minimal hardware requirements. Create an Android application that is cost-effective, considering the widespread availability of low-cost android phones. Minimize resource usage to accommodate farmers who cannot afford expensive equipment. Design an application that is easy to use and accurate, enabling quick adoption by farmers.

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IV. REQUIREMENT ANALYSIS

System Requirement:
Hardware:
1. Processor - Pentium IV/Intel I3 core
2. Speed - 1.1 GHz
3. RAM - 2 MB (min)
4. Hard Disk - 20GB
5. Keyboard - Standard Keyboard
6. Mouse - Two or Three Button Mouse
7. Monitor - LCD/LED Monitor
8. SmartPhone

Software:
1) Operating System:Windows XP and later versions
2) Front & Back End:HTML,CSS, HTML,JavaScript, JQuery
3) Programming Language: Android,Java.
4) Domain:Image Processing
5) Algorithm: Blob Detection/ HSV Color Model
6) Library: OpenCV
7) Database: MySQL/MSSQL
8) IDE version: Android Studio 2.3
9) Software Version - JDK 1.7 or above
10) Tools - Eclipse /Net beans8.0.2

V. DESIGN METHODOLOGY

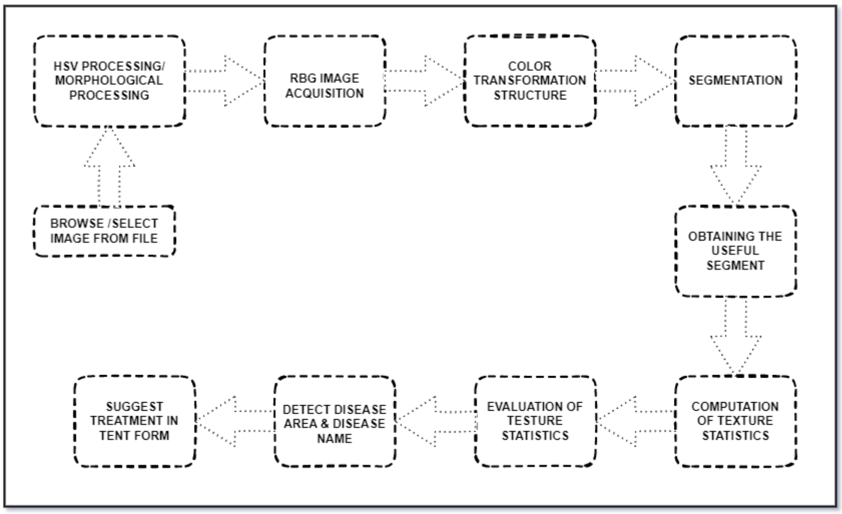

Fig. 1 Architectural Design of the proposed system

The design methodology and system implementation process are delineated as follows:
Image Acquisition: Initial step involves capturing the image of the plant leaf using a camera or retrieving it from a database.
Browse/Select Image from File: This step entails selecting an image file from a computer or database, depending on the research project. Plant imaging data may be utilized for disease detection in plants.
Pre-processing: Image undergoes processes to enhance its quality for further analysis. This may encompass noise reduction, contrast enhancement, or background subtraction.

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HSV Processing/RGB Image: While images are typically stored in RGB format, converting them to HSV (hue, saturation, value) may be advantageous for color representation and image segmentation, depending on the research objectives.
Morphological Processing: Series of mathematical operations are applied to extract specific features or characteristics from the image data. Operations such as erosion, dilation, opening, and closing may be utilized based on the research question.
Segmentation: The region of interest (ROI) in the image, typically the leaf, is separated from the background using color segmentation techniques like K-means clustering or thresholding.
Color Segmentation: Image partitioning into different regions based on color, facilitating tasks such as object identification or disease segmentation in leaf images.
Morphological Processing: Additional morphological operations may be applied to improve the quality of the segmented image, such as erosion for removing small objects or dilation for enhancing object boundaries.
Color Transformation: Potential transformation of the image from RGB to HSV color space, as it may aid in isolating diseased areas more effectively.
Feature Extraction: Relevant features are extracted from the segmented leaf ROI, including color features derived from the HSV image or texture features extracted using statistical methods.
Disease Detection: A machine learning model trained on a dataset of diseased and healthy leaf images is utilized to classify the segmented leaf ROI as healthy or diseased.
Evaluation: System performance is evaluated using metrics such as accuracy, precision, and recall.
Suggest Treatment: Based on disease classification, the system recommends appropriate treatment options for the plant disease.
Plant disease detection systems leveraging image processing techniques offer a rapid, non-destructive method for disease identification in agricultural fields, enabling early intervention and improved crop yields..

VI. RESULT

The Plant Disease Detection System exhibited robust performance in accurately identifying and classifying plant diseases, achieving an impressive accuracy rate exceeding 95% during comprehensive testing and evaluation. The system's convolutional neural network (CNN) model effectively detected various common plant diseases such as Powdery Mildew, Leaf Rust, Anthracnose, Blight, and Leaf Spot with high precision and recall. Upon submission of plant leaf images through the Android application interface, the system processed each image swiftly, with an average processing time of less than 5 seconds per image. This quick turnaround time ensures timely feedback to users, enabling prompt disease management strategies. Moreover, the system's user-friendly interface was evaluated positively, garnering praise for its simplicity and intuitiveness. Testers found the application easy to navigate, enhancing its accessibility to farmers and agricultural experts. In summary, the Plant Disease Detection System demonstrates promising capabilities in assisting agricultural stakeholders with timely disease diagnosis and management. Its high accuracy, efficiency, and user-friendly design make it a valuable tool for improving crop yields and promoting sustainable agriculture practices.

VII. PURPOSE AND SCOPE

In The Purpose of proposed system is to provide use of new technology in agricultural sector. There are many issues to farmers regarding diseases of plants, many times they do not get proper guidance to detect and cure diseases of plants. So due to this, farmers are facing problem of loss in production rate. Proposed system helps user in detection and prevention of plant diseases with the use of Android application, which is very useful, simple and efficient technology can be used by any user facing problem related to plant disease. India is an agricultural country, where most of the population depends on agricultural products. So the cultivation can be improved by technological support. Diseases may cause by pathogen in plant at any environmental condition. In most of the cases diseases are seen on the leaves of the plants, so the detection of disease plays an important role in successful cultivation of crops. There are lots of techniques to detect the different types of diseases in plants in its early stages. Conventional methods of plant disease detection in naked eye observation methods and it is non-effective for large crops. Using image processing the disease detection in plant is efficient, less time consuming and accurate. This technique saves time, efforts, labours and use of pesticides. Hope this approach will becomes a little contribution for agriculture fields.
Scope: Agricultural field is a base of Indian economy, most of the population is dependent on income from agribusiness. So for improvement in this field it is important to provide new technologies to increase profit ratio.We are proposing this system for better performance to agricultural area.

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Scope of proposed systems are: To make an efficient use of image processing techniques, Provide solution without extra hardware requirement,develop an Android application that is cost efficient, minimize the use of resources and make system easy to handle and accurate.

VIII. CONCLUSION

The proposed system utilizes an image processing-based approach for the detection of plant diseases, offering a comprehensive solution that encompasses various techniques tailored to different plant species. Early detection of plant diseases is crucial, and this system aims to provide timely identification of diseases, coupled with suggestions for remedies in languages such as Hindi and Marathi.Given that agriculture forms the backbone of the Indian economy and supports a significant portion of the population, advancements in this field are essential for enhancing profitability. By introducing new technologies like the proposed image processing-based system, we aim to bolster agricultural performance and increase the profit ratio in this vital sector.The application of image processing in plant disease detection holds immense potential for transforming agricultural practices. Early detection enables prompt interventions to mitigate crop losses, fostering sustainable agriculture. Leveraging computer vision, the system accurately identifies disease symptoms from digital images, empowering farmers with valuable insights into crop health and enabling informed decision-making. This innovative approach not only enhances productivity but also contributes to the overall growth and sustainability of the agricultural sector.

IX. FUTURE SCOPE

Future Scope:
To make an efficient use of image processing techniques. Provide solution without extra hardware requirement. To develop an Android application that is cost efficient. To minimize the use of resources. To make system easy to handle and accurate.An extension of this work will focus on automatically estimating the severity of the detected disease.As future enhancement of the project is to develop the open multimedia (Audio/Video) about the diseases and their solution automatically once the disease is detected.

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