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Turmeric Plant Leaf Oversight, Diagnosis and Recommendation for Control of Diseases by Raspberry Pi 4 and Pi Camera System

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Abstract

In the agriculture industry, disease identification is vital. As a rhizomatous crop, turmeric is widely recognized for its therapeutic use. It is vital to keep an eye on these crops. The most common diseases that affect turmeric leaves are leaf spots, leaf blotch, brown rot, dry rot, and leaf blight. The research creates a hardware system that enables early disease diagnosis and prevention before it affects the entire crop, resulting in high-quality agricultural production. Using k-means image segmentation, a database of various leaf pictures will be generated and handled. Pi camera interfaced with Raspberry Pi 4 hardware will be used to capture images of infected plants and will be used for further processing and analysis. Pesticides or insecticides will be recommended to farmers according to the status of plant disease through the use of friendly communication like WhatsApp or SMS.

Keywords: *Raspberry Pi 4, Segmentation, Leaf disease, Turmeric.*

1. Introduction

Along with a rapidly growing world population, the demand for food is also increasing. Ensuring food security for about 8 billion people worldwide necessitates reducing crop damage through prompt identification of crop diseases. The most significant and challenging duty for the agriculture industry is the identification of plant diseases. One of the significant rhizomatous crops cultivated in India is turmeric and used worldwide because of its daily use in cooking, biomedical benefits, natural colors, and natural cosmetic production. The turmeric leaves are highly exposed to nature and also invite several diseases like rhizome rot, leaf spot, dry rot, bacterial wilt, leaf blotch, etc. To identify plant diseases, careful observation is necessary and hence this is important to diagnose the [7] diseases timely and take preventive measures to reduce further damage to plants and avoid major loss. Presently, farmers follow traditional methods for disease control by going into the agricultural shops taking suggestions from shopkeepers, and purchasing the pesticides randomly without expert advice, due to this they may or may not get a satisfactory result. This method is time-consuming and if [8] satisfactory results are not achieved then it results in an irreparable loss. Hence, it is extremely important to avoid this trial-and-error basis method and waste of time in the diagnosis of diseases control the diseases in time, and avoid damage to crops. Under this circumstance monitoring, Diagnosis, and recommendation of accurate pesticides/insecticides to detect disease of turmeric plants becomes significant. So, it is essential to develop low-cost, efficient, simple, quick responding, user-friendly and hand-held systems for monitoring, diagnosis, and recommendation of accurate pesticides/insecticides for the identified disease.

2. Survey of Work Done in The Research Area & Need for More Research

2.1 The Review of Research Work Related to Plant Disease Monitoring and Detection Is as Follows

According to the 2019 study "Plant disease identification using explainable 3D deep learning on hyper spectral pictures," hyper spectral imaging is showing promise as a method for identifying plant diseases. Deep learning-based plant disease identification is a perfect fit since hyper spectral data cubes include a lot of potentially duplicate

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information. In this case, we use a brand-new 3D deep convolutional neural network (DCNN) that absorbs the hyperspectral data directly. In addition, we probe the learned model to generate physiologically relevant explanations. We concentrate on charcoal rot, a soil-borne fungal disease that has a significant economic impact and lowers soybean crop yields globally. [1] "Performance analysis of deep learning CNN models for disease detection in plants using image Segmentation" published in 2020. By training the convolutional neural network (CNN) models with segmented picture data, this research explores a possible solution to this issue. When tested on independent data previously unseen by the models, even with 10 disease classifications, the S-CNN model trained using segmented images more than doubles in performance to 98.6% accuracy as compared to the F-CNN model trained using whole images. [2] "Detection of plant leaf diseases using image segmentation and soft computing techniques" published in 2017. The algorithm for image segmentation technique, which is employed for autonomous plant leaf disease detection and classification, is presented in this study. It also includes a study of the many disease categorization methods that can be applied to the identification of plant leaf diseases. Genetic algorithms are used for image segmentation, a crucial step in the diagnosis of plant leaf disease. [3] Various image processing and machine learning approaches are utilised to identify and categorise the diseases in turmeric leaves, according to a 2016 publication titled "Identification and Classification of Leaf Diseases in Turmeric Plants." To facilitate effective feature extraction, the 800 leaf images in the dataset were pre-processed and separated into several groups. The model was trained using machine learning strategies such as naïve bayes, decision trees, and support vector machines [9]. 10-fold cross-validation was used to assess the model's performance, and the findings are shown. [4] "Intelligent Plant Disease Identification System Using Machine Learning" published in 2020. In this work, a video sensor module was combined with a real-time decision support system to facilitate the identification of plant diseases. Additionally, the effectiveness of three machine learning algorithms—including Support Vector Machine (SVM) and Extreme Learning Machine (ELM)—using polynomial and linear kernels was examined. The results show that the selected support vector machine classifier is not as effective as the extreme learning machine. Additionally, it is noted that in comparison to the other classifiers, the support vector machine with a polynomial kernel has superior sensitivity. Because several plant illnesses can be detected by the real-time hardware built, this work seems to have considerable social relevance. [5] Image segmentation, according to the 2021 publication "On Comparison of Different Image Segmentation Techniques," is the division of image pixels into discrete zones that are either identical or as closely associated as feasible in terms of brightness, texture, or color. Numerous images processing tasks, including object detection, machine vision, image compression, and image treatment, can benefit from picture segmentation [10]. This work will offer a thorough analysis of several image segmentation methods. We will evaluate the advantages and disadvantages of each of the current approaches and compare them with one another. [6] However, it has been observed that there is less research work regarding hardware system design and implementation for the immediate diagnosis of diseases and recommendation pesticides/insecticides of the plant disease. Hence, I would like to introduce a cost effective, user friendly and less transient time system for the plant disease detection and control.

3. Methodology & Techniques to Be Used

The methodology and techniques of research work is as follows:

3.1 Hardware System Using Raspberry Pi and High-Resolution Pi Camera

In this research Raspberry Pi 4 board is shown in Figure 1 used which is 64-bit quad core cortex-A72 ARM v8, BCM2711 and runs at 1.5GHz, equipped with Bluetooth 5.0, Ethernet 802.11ac wireless at 2.4GHz & 5GHz, USB 3.0 & 2.0, two HDMI ports. A 12.3 Megapixel Sony IMX477 sensor with a 7.9mm diagonal image size, back-illuminated sensor architecture, adjustable back focus, and 1.55µm x 1.5µm pixel size is employed in this research as a Raspberry Pi high-quality camera.

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3.2 Develop Software System to Capture the Image Using a Pi Camera

With the reference of the hardware systems explained and developed as above, capture the image and store it in memory for further analysis. The file format to store this image will be common accessible i.e. in jpg, jpeg, png format [11] so that information can be easily shared using through the WhatsApp or SMS and supportive decisions can be given for getting more accurate result and farmer can order for the suggested pesticides/insecticides. If he is speculative about the suggestions, then he can communicate the same to agricultural expert though WhatsApp or SMS. [12]

3.3 To Develop Algorithms and Software to Diagnose the Diseases Using Uploaded Reference Data into The System

As per the methods suggested for image processing in the subject Mathematical Morphology, use algorithms namely Image segmentation. After image processing, the processed [13] image will be compared with images stored in the reference library. Then a comparative result of two images will be generated and provided to the farmer. [14]

3.4 Accordingly Recommend the List of Pesticides/Insecticides for Controlling the Identified Disease

Recommendations for use of pesticides/insecticides to control diseases are done using either of the Greedy or KNN algorithms used for comparative study of two images.

3.5 Verifying The Developed System by Field Visit in Satara District in Maharashtra, India, Data Collection, Data Modification According to The Observations and Prepare the Report

The developed system will be tested by field visit at various places in Satara district and study report will be generated accordingly. Developing hardware system step by step process in Figure 2.

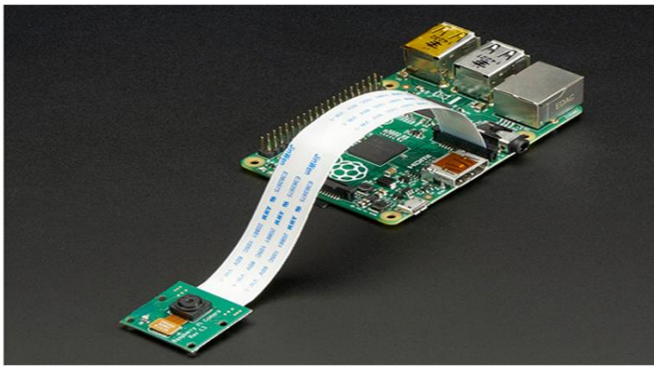

Figure 1 Raspberry Pi 4 Board

3.6 Process Flow

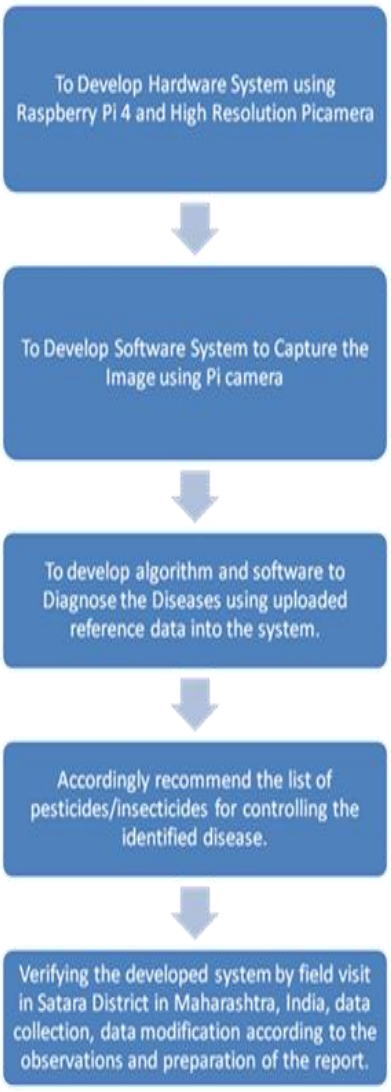

Figure 2 Developing Hardware System Step-by-Step Process

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Conclusion

The research has modeled Turmeric Leaf Oversight, Diagnosis, and Recommendation for the control of Diseases by Raspberry Pi 4 and Pi Camera System. In this paper, we explored the many diseases that damage turmeric plants. Image segmentation techniques can be used to accurately detect turmeric leaf disease. The work involves hardware design and implementation using Raspberry Pi 4 and Pi camera. Database creation for different diseases of turmeric leaf and accordingly suggest different insecticides or pesticides. The research can be expanded in the future by utilizing various methods for dividing the original leaf's sick area.

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