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Fruit Scan - Disease Identification in Fruits Using Image Processing

Tejas Chaudhari[1], Anushka Raut[2], Devraj Jadhavrao[3], Prof. V. S. Kadam[4]
Department of Computer Engineering, Sinhgad Institute Of Technology, Lonavala

Abstract: The agricultural industry plays a crucial role in sustaining global food security, and the health of fruit crops is paramount in ensuring a steady food supply. Fruit diseases pose a significant threat to crop yield and quality, making their early detection and management essential. In recent years, the integration of technology and artificial intelligence has transformed fruit disease detection, offering more accurate and efficient solutions. This abstract provides an overview of the techniques and challenges associated with fruit disease detection. This review highlights various methodologies employed in fruit disease detection, including computer vision, machine learning, and sensor-based approaches. Computer vision, powered by deep learning algorithms, has enabled the automated identification of disease symptoms based on image analysis. Machine learning models, such as neural networks and support vector machines, have been deployed to classify disease types, predict disease severity, and assist in decision-making for disease management. Sensor-based techniques, like hyperspectral imaging and electronic nose systems, offer non-invasive and real-time monitoring of fruit health. Despite the progress in fruit disease detection techniques, several challenges persist. These include data acquisition and labelling, the need for robust and transferable models, scalability, and the integration of multiple technologies. Furthermore, the deployment of these technologies in the field may require addressing issues related to resource constraints, infrastructure, and the digital divide in agricultural communities.
Keywords: CNN, Convolutional neural network, Deep learning, Analysing visual imager.

I. INTRODUCTION

In today's agriculture, ensuring the health and quality of fruits is critical for farmers and consumers alike. Bacteria, fungi, viruses, pests, and environmental factors all have the potential to infect fruits. These diseases have the potential to significantly impact crop yield, shelf life, and economic sustainability. Early detection and diagnosis of these diseases are critical for implementing effective preventive or curative measures. Traditional disease detection methods in fruits frequently involve manual inspection by experts, which is time-consuming, subjective, and error prone. However, with advances in image processing and computer vision, automated systems can be created to identify fruit diseases efficiently and accurately by analysing digital images of the fruit's surfaces. This research focuses on using image processing techniques to detect diseases in fruits. We will capture high-resolution images of fruit samples using cameras or smartphone cameras. These images will be processed using sophisticated algorithms and machine learning models to identify patterns and features associated with different diseases. Fruit disease detection is an essential aspect of modern agriculture and horticulture. It involves the use of various technologies and techniques to identify, diagnose, and manage diseases that affect fruit crops. These diseases can have a significant impact on crop yield, quality, and overall agricultural productivity. Detecting and managing these diseases is crucial for sustainable food production, reducing economic losses, and ensuring the availability of high-quality fruit for consumers. Fruit disease detection is a critical component of agriculture that is evolving with technological advancements, ultimately leading to improved crop health, productivity, and economic stability for farmers and the agricultural industry as a whole.

II. METHODOLOGY

Disease detection in fruit crops is critical for keeping orchards healthy and productive, as well as ensuring fruit quality. There are several methodologies and techniques that can be used to detect fruit diseases. Here's a list of common methods:

A. Visual Inspection

Visually inspect the fruit and leaves for signs of disease, such as discoloration, spots, lesions, or deformities. Farmers and field experts can identify common diseases based on their appearance, but this method has limited accuracy.

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B. Remote Sensing

Drones and satellites can collect multispectral and hyperspectral images of orchards. These images can be used to identify disease-related changes in plant health. Disease symptoms can be identified using specific light wavelengths.

C. Imaging and Computer Vision

Apply machine learning and computer vision techniques to analyse images of fruits and leaves taken with cameras or smartphones. CNNs can be trained to recognize and classify disease symptoms.

D. Spectroscopy

Spectroscopy measures how light interacts with plant tissues. Near-infrared (NIR) and mid-infrared (MIR) spectroscopy can be used to identify disease-related changes in plant tissues. Non-destructive techniques offer valuable information on chemical composition of the plants.

E. Hyperspectral Imaging

Captures a spectrum of light for each pixel, detecting subtle differences in plant health and disease symptoms. Advanced data analysis techniques are utilized to identify and map diseases in orchards.

F. DNA-Based Techniques

PCR and DNA sequencing can detect pathogens and disease-associated genes in fruit crops. While highly accurate, these techniques often need to be performed in a laboratory setting.

G. Expert Systems

Computer-based systems use plant pathology knowledge and field data to diagnose diseases and provide management recommendations.

H. Data Analytics and Artificial Intelligence (AI)

Analysing historical data on disease occurrence and environmental conditions can aid in disease prediction and management through AI and machine learning algorithms.

Combining multiple methods, such as remote sensing and artificial intelligence (AI), can improve disease detection accuracy and provide early warnings to farmers, allowing them to take timely action to manage and prevent diseases in fruit crops. The methodology chosen is determined by cost, available technology, and the specific disease or crop under consideration.

III.LITERATURE SURVEY

Mukesh Kumar Tripathi et al: In this paper, we investigate the paper broadly related to fruits and vegetables among various horticulture products of agriculture fields, specific model, data pre-processing, data analysis method, and overall value of performance accuracy using a specific performance metric. Furthermore, we investigate the different types of disease found in various fruits and vegetables. We also compared different machine learning approaches on the same dataset using various performance metrics.

R. Thanusri et al: This RESNET 152 deep CNN-based model was developed to determine the mellowness of dragon fruit. Training and testing were carried out using live photos of dragon fruit at various stages. Unlike the VGGNET, which loses accuracy as the network becomes more complicated and the number of epochs increases, the results obtained showed greater precision in testing and training even with an increased number of epochs.

Guobin Shi et al: The conclusions of this study are as follows: 1. The proposed on-board image processing algorithm outperformed the other tested algorithms (i.e., algorithm-1 and algorithm-2) in terms of apple segmentation accuracy, with 57.78% for three clusters (k=3) using the k-means++classifier. The customized algorithm was missing and segmentation errors of 12.09% and 0.13%, respectively.

Tharindu Dharmasena et al.: This paper proposes an automated system for optimally controlling climate and irrigation in a greenhouse by monitoring temperature, soil moisture, humidity, and pH via a cloud-connected mobile robot that can detect unhealthy plants using image processing. A fuzzy controller will use sensor readings to control the greenhouse's heating and cooling system, irrigation system, and humidifiers.

J. Rex Fiona et al: In this paper, we examined the various applications of image processing in agriculture, including crop analysis, detection, and identification of plant diseases.

Santhosh Kumar S et al.: Farmers are unaware of the crops that thrive on their land. When plants are affected by heterogeneous diseases through their leaves, it has an impact on agricultural production and results in a profit loss. There has also been a reduction in both the quality and quantity of agricultural production. Leaves are essential for rapid plant growth and increased crop production. Identifying diseases in plant leaves can be difficult for both farmers and researchers.

Mehmet Metin Ozguven et al: Several researchers have recently conducted extensive research into the potential applications of image processing and machine learning for disease detection in plants and leaves. Despite the fact that several methods and computer algorithms have been developed in this field of research, there is still room for advancement. The majority of previous models addressed only a few morphological characteristics of the diseased areas. In the current study, the Updated Faster R-CNN model, developed by changing the parameters of the CNN architecture, was used to automatically detect diseased areas in sugar beet leaves.

Vippon Preet Kaur et al.: In this study, the authors proposed the Fuzzy Rule-Based Approach for Disease Detection (FRADD) for detecting and classifying the most common apple diseases in Kashmir valley (particularly apple scab). The basic steps of FRADD. This approach involves several stages, ranging from image collection to classification, which are depicted below. The framework for the proposed approach.

V S Magomadov et al.: Deep learning is a data analysis and image-processing method that has recently gained popularity as a tool with enormous potential and promising results. Deep learning has been applied to many different fields, including agriculture. The purpose of this paper is to investigate deep learning in agricultural and food production. This paper focuses on the performance of deep learning in agriculture and compares it to other existing artificial intelligence models that have been used in agriculture.

Prabira Kumar Sethy et al.: This paper proposes a method of categorizing dissimilar diseases for identifying infected plants' green foliage. It also recommends and evaluates intuitive image dissection and cataloguing techniques by defining a layered set of rules for infected plants. From an execution standpoint, the proposed methodology was successfully tested and verified on a variety of rice leaf diseases, including bacterial blight, brown spot, leaf scald, and leaf blast.

IV. PROPOSED METHODOLOGY

The methodology for diagnosing fruit diseases consists of several tasks, including image acquisition, image preprocessing, image feature extraction, and classification of fruit diseases based on image features such as colour, shape, and texture. The first stage is the image acquisition phase. This step involves uploading images from various datasets. In the second phase, image preprocessing is completed. In the third phase, image feature extraction for the infected portion of the leaf is completed using specific properties of pixels in the image or their texture. Following this step, certain statistical analysis tasks are completed to classify the features that represent the given image by comparing image features using machine learning algorithms. Finally, the classification results reveal the identified fruit disease.

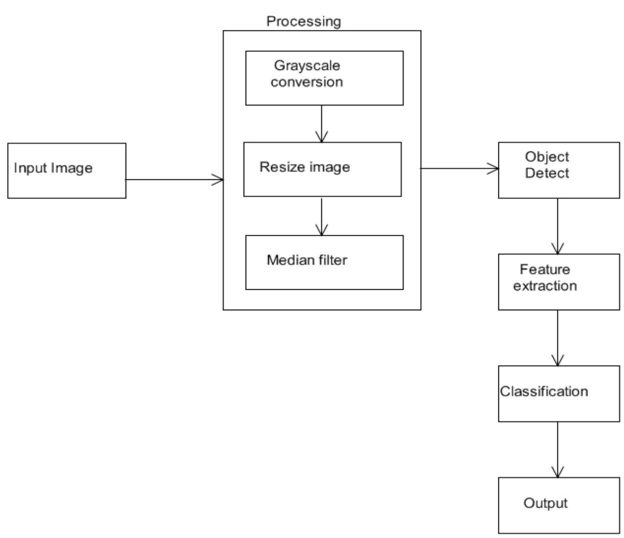

Fig. 1: System Architecture

1) *Input Image:* Here will upload the Input fruit Image.
2) *Image Preprocessing:* In this step will applying the image preprocessing methods like grayscale conversion, image noise removal for further processing.
3) *Image Feature Extraction:* In this step will applying the image thresholding and edge detection methods to extract the cell nuclei from fruit image and count that.
4) *Image Classification:* In this step will applying the image classification methods like CNN algorithm to classify the diseases.
5) *Result:* In this step will show the final fruit disease result.

V. ALGORITHM

A. *Convolution Neural Network (CNN)*

The structure of CNN includes two layers. The feature extraction layer connects each neuron's input to the previous layer's local ready fields and extracts the local feature. Once local features have been extracted, the positional relationship between them and other features will be displayed. The other is the feature map layer; each computing layer in the network takes advantage of the feature map. Every feature map is a plane, and the weights of the neurons in the plane are equal. The feature plan structure uses the sigmoid function as the convolution network's activation function, resulting in a shift in difference in the feature map. Furthermore, because the neurons in the same mapping plane share weight, the number of free parameters in the network is reduced. Each convolution layer in the convolution neural network is followed by a computing layer, which is used to calculate the local average and the second extract; this unique two-feature extraction structure reduces resolution.

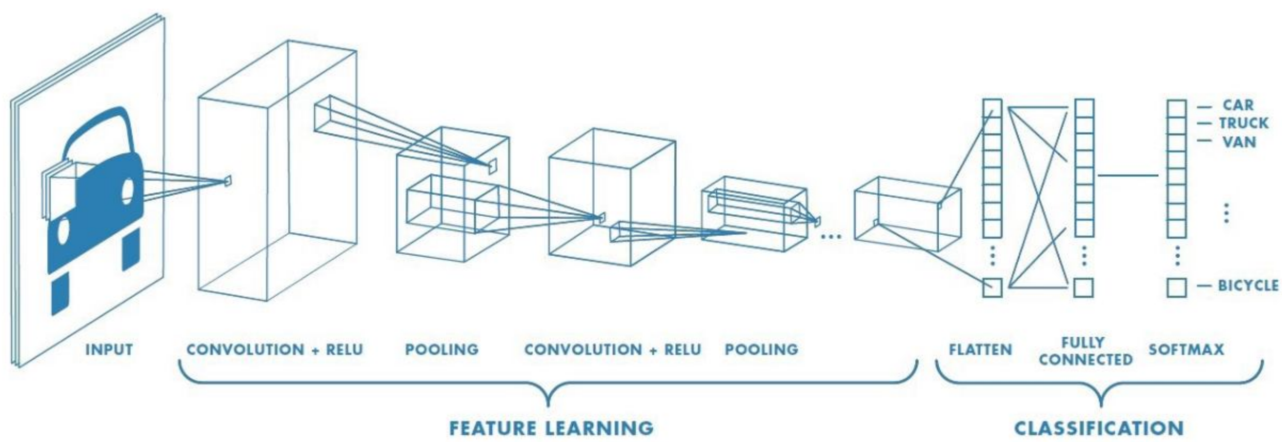

Fig. 2: CNN Layers

B. *Convolutional Layer*

Convolution is the first layer that extracts features from an input image (the leaf image). Convolution maintains the relationship between pixels by learning image features from small squares of input data. Convolution of an image with various filters can perform operations such as edge detection, blur, and sharpening by applying filters such as the identity filter, edge detection, sharpen, box blur, and Gaussian blur filter.

C. *Pooling Layer*

When images are too large, pooling layers can reduce the number of parameters. Spatial pooling, also known as subsampling or downsampling, reduces the dimensionality of each map while retaining important information.

D. *Fully Connected Layer*

In this layer, the feature map matrix will be converted to a vector (x1, x2, x3,...). We used fully connected layers to combine these features into a model.

E. *SoftMax Classifier*

Finally, we use an activation function like softmax or sigmoid to classify the outputs, i.e. leaf disease.

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VI. RESULT AND DISCUSSION

The section shows overall accuracy of CNN classification technique. So, this works gives better fruit disease prediction compare to existing method.

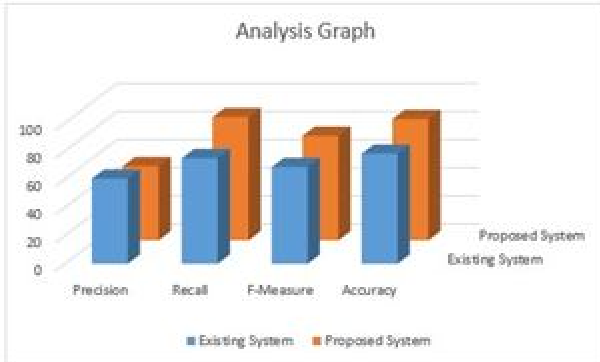

Fig. 3: CNN Classification Accuracy Graph

Table 1: Method Comparison

	Existing System	Proposed System (CNN)
Precision	60.6	52.70
Recall	75.1	87.64
F-Measure	68.8	74.31
Accuracy	78.29	86.26

VII. CONCLUSION

In order for people to make a significant contribution to the global economy and for farmers and agriculturalists to live happy, prosperous, and healthy lives, the plants that are being grown should be free of disease and pests. With the aid of image processing and the suggested algorithm, these things are literally possible. The use of CNN algorithms paves a simple method for spotting disease on fruits and aids in separating diseased fruit from good fruit. This strategy may quickly detect and classify the fruits utilizing image processing techniques based on these approaches and algorithms. Our project's main goal is to increase the value of fruit disease detection.

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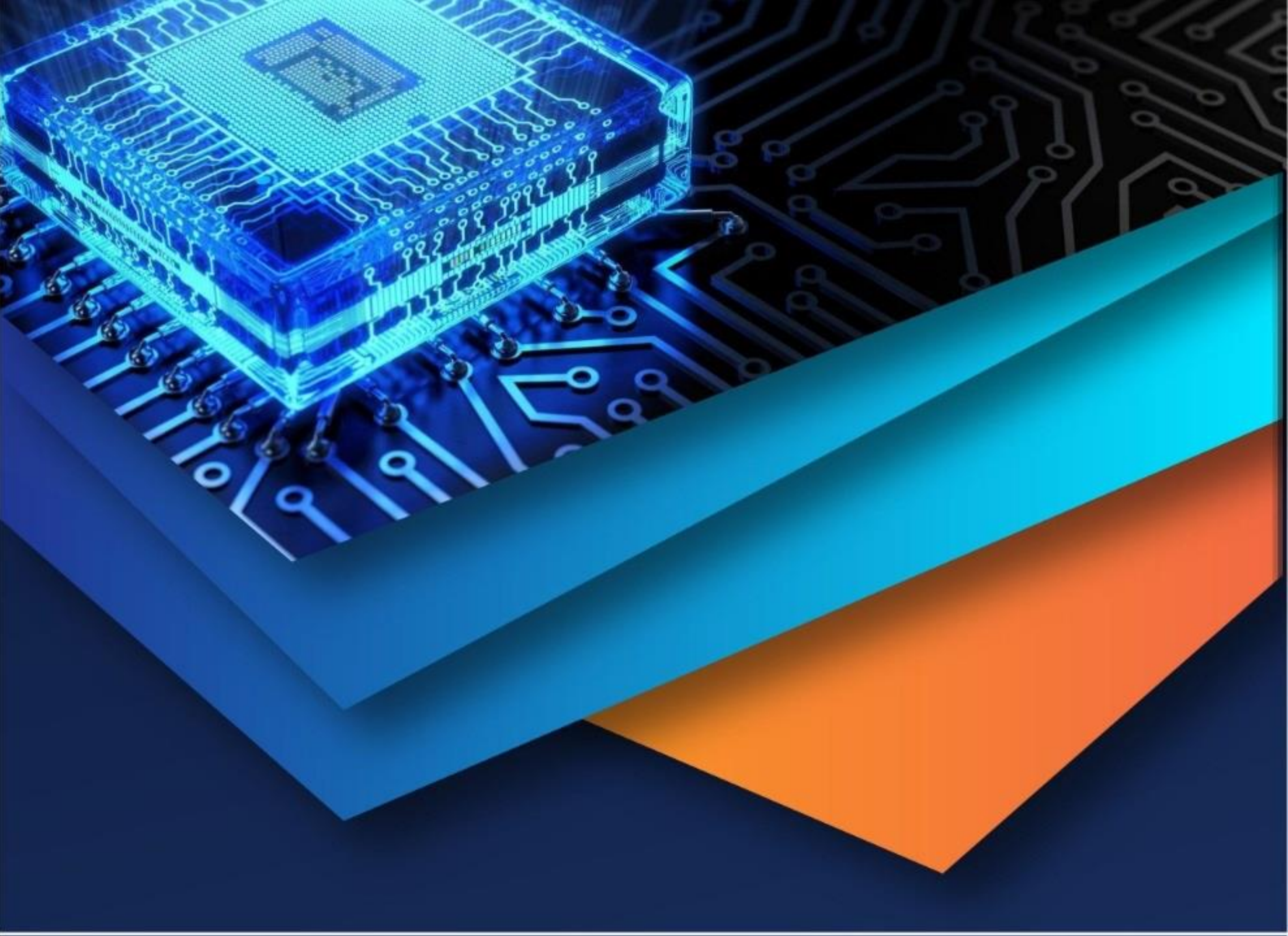

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