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# FRUIT INSPECT – DISEASE IDENTIFICATION IN FRUITS USING IMAGE PROCESSING

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## ABSTRACT

The agricultural business is critical to maintaining global food security, and the health of fruit crops is critical to providing a consistent food supply. Fruit infections are a major danger to crop productivity and quality, making early detection and management critical. The merging of technology and artificial intelligence has improved fruit disease diagnosis in recent years, providing more accurate and efficient solutions. This abstract provides an overview of the approaches and challenges involved in detecting fruit disease. This review focuses on several fruit disease detection strategies, such as computer vision, machine learning, and sensor-based systems. Deep learning techniques in computer vision have enabled the automatic diagnosis of illness signs 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

It is critical in modern agriculture to ensure the health and quality of fruits for both farmers and consumers. Bacteria, fungus, viruses, pests, and environmental variables can all cause illnesses in fruits. These diseases have the potential to drastically reduce crop output, shelf life, and economic sustainability. It is critical to discover and diagnose these disorders as soon as possible in order to apply suitable preventive or therapeutic actions. Traditional techniques of disease identification in fruits frequently rely on professional manual inspection, which is time-consuming, subjective, and prone to error. However, with advances in image processing and computer vision, automated systems that analyze digital photographs of fruit surfaces can be built to identify fruit illnesses efficiently and accurately. In this study, we will use image processing techniques to detect illnesses in fruits. We will use cameras or smartphone cameras to obtain high-resolution photos of fruit samples. To detect patterns and traits linked with various diseases, these photos will be processed using sophisticated algorithms and machine learning models. Fruit disease identification is critical in modern agriculture and horticulture. It entails the use of numerous technologies and strategies to identify, diagnose, and manage fruit crop illnesses. These diseases have the potential to significantly reduce crop yield, quality, and overall agricultural productivity. Detecting and controlling these illnesses is critical for long-term food production, decreasing economic losses, and ensuring consumer access to high-quality fruit. Fruit disease detection is an important step. 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. LITERATURE SURVEY

**1. Mukesh Kumar Tripathi et al.:** In this paper, we examine 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 by using a particular performance metric. Moreover, we study the different type of disease present in various fruit and vegetable. We have also focused on the comparison of different machine learning approach with respect to different performance metrics on the same dataset.

**2. R. Thanusri et al.:** This RESNET 152 deep CNN-based model has been created to assess the mellowness of the dragon fruit. Training and testing processes were carried out using the live photos captured on the varying stages of the dragon fruit. Contrary to the VGGNET, where accuracy decreases because the network becomes complicated and the number of epochs gets higher, the results obtained showed greater precision in testing and training even in the expanded number of epochs.

**3. Guobin Shi et al.:** The following are the conclusions from this study: 1. The proposed on-board image processing algorithm demonstrated the best apple segmentation performance among tested algorithms (i.e., algorithm-1 and algorithm-2) with the highest segmentation accuracy of 57.78% for three clusters (k=3) using k-means++ classifier. The customized algorithm had missing and segmentation errors of 12.09% and 0.13%, respectively.

**4. Tharindu Dharmasena et al.:** This paper proposes a automated system to optimally control the climate and irrigation in a greenhouse by monitoring temperature, soil moisture, humidity and pH through a cloud connected mobile robot which can detect the unhealthy plants using image processing. A fuzzy controller will control the heating and cooling system, irrigation system and humidifiers installed in the greenhouse based on the sensor readings.

**5. J. Rex Fiona et al.:** In this paper, we have analyzed the various applications of image processing in field of agriculture pertaining to areas such as crop analysis, detection and identification of plant diseases.

**6. Santhosh Kumar S et al.:** Farmers are unaware of what kind of crops that grows well on their land. When plants are affected by heterogeneous diseases through their leaves that will effects on production of agriculture and profitable loss. Also reduction in both quality and amount of agricultural production. Leaves are important for fast growing of plant and to increase production of crops. Identifying diseases in plants leave is challenging for farmers also for researchers.

**7. Mehmet Metin Ozguven et al.:** Recently, potential use of image processing and machine learning for disease detection in plants and leaves has been extensively explored by several researchers. Despite several methods and computer algorithms developed in this area of research, there is still room for improved achievements. Majority of previous models address only a couple of morphological attributes of the diseased areas. In present study, Updated Faster R-CNN model, developed by changing the parameters of CNN architecture, was used in order to automatically detect diseased areas in sugar beet leaves.

**8. Vippon Preet Kour et al.:** In this study the authors have proposed Fuzzy Rule-Based Approach for Disease Detection (FRADD) for detection and classification of the most prevalent apple diseases in Kashmir valley (particularly apple scab). The basic steps of FRADD. In this approach, different stages are involved from image collection to the classification and these steps are depicted below. The framework of the proposed approach.

**9. V S Magomadov et al.:** Deep learning is a data analysis and image-processing method, which has recently gained a lot of attention as a tool, which has great potential and promising results. There are many different fields that deep learning has been applied to and it is also being applied to the field of agriculture. The purpose of this paper is to explore deep learning in terms of agriculture and food production. The performance of deep learning in agriculture is the focus of this paper comparing it to other existing artificial intelligence models, which have been used in agriculture.

**10. Prabira Kumar Sethy et al.:** In this paper it suggests a method of dissimilar disease cataloguing for the green foliage identification of the infected plants. It also recommends and assesses an instinctive image dissection and cataloguing techniques by framing a layered set of rules for the infected plants. From the execution point of view, the proposed methodology was tried and verified on various kind of rice leaf diseases like bacterial blight, brown spot, leaf scald and leaf blast successfully.

## III. METHODOLOGY

Detecting diseases in fruit crops is essential for maintaining the health and productivity of orchards and ensuring the quality of fruit production. Several methodologies and techniques can be employed for fruit disease detection. Here's an overview of the common methods:

**1. Visual Inspection:**

The simplest method involves visual inspection of the fruit and leaves for symptoms of diseases such as discoloration, spots, lesions, or deformities. Farmers and field experts can identify common diseases based on their appearance, but this method is limited in its accuracy.

**2. Remote Sensing:**

Remote sensing technologies, including drones and satellites, can capture multispectral and hyperspectral images of orchards. These images can be analyzed to detect disease-related changes in plant health. Specific wavelengths of light are used to identify the spectral signatures associated with disease symptoms.

**3. Imaging and Computer Vision:**

Machine learning and computer vision techniques can be employed to analyze images of fruits and leaves captured using cameras or smartphones. Convolutional Neural Networks (CNNs) can be trained to recognize disease symptoms and classify them.

**4. Spectroscopy:**

Spectroscopy measures the interaction of light with plant tissues. Near-infrared (NIR) and mid-infrared (MIR) spectroscopy can be used to detect disease-related changes in plant tissues. These techniques are non-destructive and can provide valuable information about the chemical composition of the plants.

**5. Hyperspectral Imaging:**

Hyperspectral imaging captures a spectrum of light for each pixel in an image, allowing for the detection of subtle variations in plant health and disease symptoms. Advanced data analysis techniques are used to classify and map diseases in orchards.

**6. DNA-Based Techniques:**

Polymerase Chain Reaction (PCR) and DNA sequencing can be used to identify the presence of pathogens or specific genes associated with diseases in fruit crops. These techniques are highly accurate but often require a laboratory setting.

**7. Expert Systems:**

Computer-based expert systems combine knowledge of plant pathology with data from the field to make disease diagnoses. They can provide recommendations for disease management.

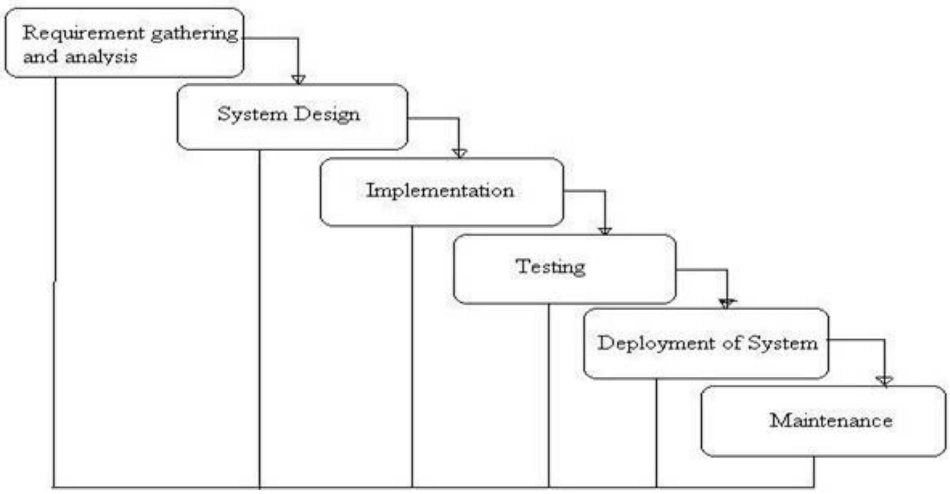
**8. Data Analytics and Artificial Intelligence:**

Collecting and analysing historical data on disease occurrence and environmental conditions can help in disease prediction and management using AI and machine learning algorithms.

Combining multiple methods, such as remote sensing and AI, can enhance disease detection accuracy and provide early warnings for farmers, helping them take timely actions to manage and prevent diseases in fruit crops. The choice of methodology depends on factors such as cost, available technology, and the specific disease or crop in question.

## IV. MODELING AND ANALYSIS

General Overview of "Waterfall Model"



The Waterfall Model is sequential design process, often used in Software development processes, where progress is seen as flowing steadily download through the phase of conception, Initiation, Analysis, Design, Construction, Testing, Production/Implementation and Maintenance. This Model is also called the classic Life cycle model as it suggests a systematic sequential approach to software developments. This one of the oldest models followed in software engineering. The process begins with the communication phase where the customer specifies the requirements and then progress through other phases like planning, modeling, construction and deployment of the software.

There are 5 Phase of water fall model:

**1. Communication**

In the communication phase the major task performed is requirement gathering which helps in finding out exact need of customer. Once all the needs of the customer are gathered the next step is planning.

**2. Planning**

In planning major activities like planning for schedule, keeping tracks on the processes and the estimation related to the project are done. Planning is even used to find the types of risks involved throughout the projects. Planning describes how technical tasks are going to take place and what resources are needed and how touse them.

**3. Modeling**

This is one the important phases as the architecture of the system are designed inthis phase. Analysis is carried out and depending on the analysis a software model is designed. Different models for developing software are created depending on the requirements gathered in the first phase and the planning done in the second phase.

**4. Construction**

The actual coding of the software is done in this phase. This coding is done on the basis of the model designed in the modeling phase. So, in this phase software is actually developed and tested.

**5. Deployment**

In this last phase the product is actually rolled out or delivered installed at customer's end and support is given if required. Feedback is taken from the customer to ensure the quality of the product. From the last two decades Waterfall model has come under lot of criticism due to its efficiency issues. So let's discuss the advantages and disadvantages of waterfall model.

## V. CONCLUSION

Plants should be free of disease and pests in order for people to make a significant contribution to the global economy and farmers and agriculturalists to live happy, prosperous, and healthy lives. These things are literally possible with the help of image processing and the suggested algorithm. The use of CNN algorithms paves the way for a simple method of detecting disease on fruits and aids in the separation of diseased fruit from healthy fruit. Using image processing techniques based on these approaches and algorithms, this strategy can quickly detect and classify the fruits. The primary goal of our project is to increase the value of fruit disease detection.

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