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## International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

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# Dragon Fruit Disease Detection Using CNN

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**ABSTRACT:** Dragon fruit is a significant tropical crop cultivated as food and commercial products due to its nutritional and economical properties. Plant diseases are having a detrimental impact on the quality and quantity of dragon fruit production causing farmers monetary losses [6]. The early and accurate detection of these diseases play a vital role in the management of crop. In this work, we provide a CNN (Convolutional Neural Networks) based disease detection system for dragon fruit plants which is a prominent deep learning technique in image level tasks. The dataset comprises a collection of dragon fruit images, both normal and diseased. Techniques like rescaling, normalization, and data augmentation are used before feeding to the model to enhance its performance and robustness. Important elements are automatically extracted from the photos by the CNN model, which then categorizes them into several disease groups. According to experimental data, the suggested method can reliably detect infections at an early stage, allowing for prompt intervention and minimizing crop damage. By offering a quick, dependable, and automated way to track the health of dragon fruit plants and raise overall agricultural productivity, the technology can help farmers and agricultural professionals.

**KEYWORDS:** CNN, Deep Learning, Dragon Fruit, Disease Detection, Image Classification

## I. INTRODUCTION

Dragon fruit is an important tropical fruit crop that is widely cultivated due to its high nutritional and commercial value. However, dragon fruit plants are highly affected by various diseases caused by fungi, bacteria, and environmental conditions, which reduce crop quality and yield. Early and accurate disease detection is essential for improving productivity and minimizing economic losses for farmers. Traditional disease identification methods are time-consuming and depend heavily on expert knowledge. Convolutional Neural Networks (CNN), a deep learning technique, provide an efficient solution for automatic image-based disease detection. CNN models can learn disease patterns from leaf and fruit images with high accuracy and speed. This project focuses on developing a CNN-based system for detecting diseases in dragon fruit plants to support smart and precision agriculture.

## II. LITERATURE REVIEW

Recent studies in plant disease detection have shown that deep learning techniques, especially Convolutional Neural Networks (CNN), achieve high accuracy in identifying crop diseases from images. Researchers have successfully applied CNN models such as AlexNet, VGG16, ResNet, and MobileNet for detecting diseases in fruits and leaves. Several works focused on improving image preprocessing, feature extraction, and classification performance to enhance detection accuracy. Existing research on dragon fruit disease detection is limited, creating a need for a specialized and efficient detection system. Therefore, this project aims to develop a CNN-based model that can accurately identify dragon fruit diseases and support farmers in early diagnosis and treatment.

Ref. Paper No.	Title Of Paper	Methodology Used	Outcomes	Future Scope
1	Deep Neural Network Model for Plant Disease Recognition[1]	Deep Neural Networks (DNN) for image classification	Achieved high accuracy in multiple plant diseases	Improve real-time disease detection and dataset diversity
2	Deep Learning Applications in Agriculture[2]	Review of deep learning techniques in agriculture	Highlighted applications in crop monitoring and disease detection	Integration with IoT and smart farming systems



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3	Dragon Fruit Leaf Disease Detection Using CNN [3]	CNN-based image analysis for dragon fruit leaves	Demonstrated effectiveness of CNN models in disease detection	Enhance accuracy with larger datasets and transfer learning
4	Evaluation of Deep Learning Architectures for Plant Disease Detection[4]	Compared various CNN architectures such as AlexNet, VGG, and ResNet	Reported high classification accuracy across plant diseases	Develop lightweight models for mobile applications
5	Machine Learning and Deep Learning for Plant Disease Detection [5]	Image-based classification using ML and DL algorithm	Improved disease prediction and classification performance	Use hybrid models for better feature extractio
6	Comparative Analysis of Optimized CNN Models[6]	Refined and optimized CNN architecture	Increased accuracy in plant disease identification	Optimize models for faster training and deployment
7	Novel CNN Design for Plant Disease Diagnosis [7]	Proposed a custom CNN architecture	Enhanced classification performance and detection accuracy	Apply the model to multiple crop disease datasets
8	Deep Learning-Based Agricultural Image Classification [8]	Deep learning image classification techniques	Successful application in agricultural disease identification	Expand applications to precision agriculture
9	Automated Plant Disease Identification Using CNN [9]	Automated CNN-based disease classification syste	Accurate classification of infected plant images	Integrate with mobile and cloud-based systems
10	Deep Learning Principles and Advancements [10]	Overview of deep learning concepts and advancement	Explained the importance of deep learning in AI applications	Apply advanced DL techniques in agricultural automation

### III. METHODOLOGY OF PROPOSED SURVEY

The proposed system uses Convolutional Neural Network (CNN) techniques to detect diseases in dragon fruit plants through image analysis. Initially, a dataset of healthy and diseased dragon fruit leaf and fruit images is collected from different agricultural sources. The collected images are then preprocessed using resizing, noise removal, normalization, and image augmentation techniques to improve data quality and increase model performance.

After preprocessing, the dataset is divided into training and testing sets. A CNN model is designed and trained to automatically extract important features such as color, texture, and disease patterns from the images. The trained model classifies the images into different disease categories or healthy classes based on learned features.

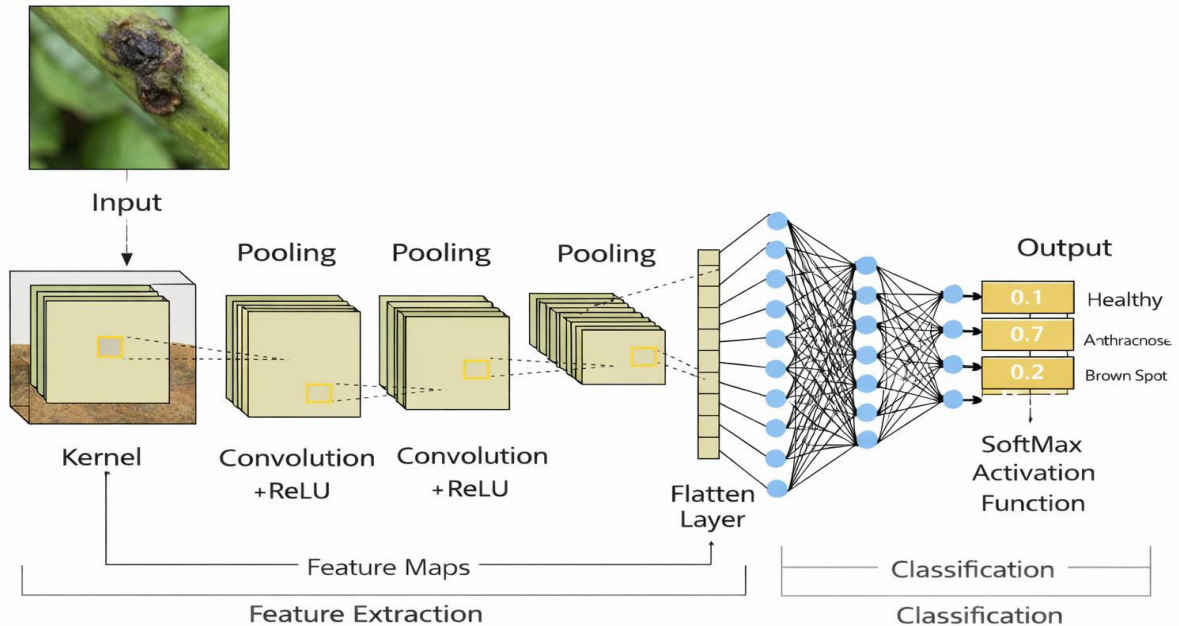
The performance of the proposed model is evaluated using parameters such as accuracy, precision, recall, and loss function. Finally, the developed system can assist farmers in early disease detection, reducing crop damage and improving agricultural productivity through smart farming techniques.



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### Plant Stem Disease Detection using CNN



**Fig 1: Block diagram of CNN architecture**

The suggested Convolutional Neural Network (CNN) model is intended to automatically extract discriminative visual characteristics from pictures of dragon fruit in order to classify diseases. The architecture uses a hierarchical method for extracting feature.

**A. Input Layer:** An RGB image of fixed size ( $200 \times 200 \times 3$ ) is provided as input, and pixel values are normalized between 0 and 1 for stable training.

**B. Convolutional Layers:** Convolutional layers extract important features such as edges, textures, and disease patterns using learnable filters, where the convolution operation is given by  $F(i, j) = \sum \sum I(i - m, j - n) \cdot K(m, n)$  where  $I$  represents the input image,  $K$  denotes the convolution kernel, and  $F$  indicates the resulting feature map.

**C. Activation Function:** The Rectified Linear Unit (ReLU) introduces non-linearity into the network and is defined as  $f(x) = \max(0, x)$ , improving training efficiency and enabling the model to learn complex disease features.

**D. Pooling Layers:** Max pooling reduces spatial dimensions and computational complexity while preserving important features, and the pooling operation is expressed as  $P(i, j) = \max_{(m,n) \in R} F(i + m, j + n)$

Pooling improves translation invariance and helps reduce overfitting.

**E. Flatten Layer:** The flatten layer converts extracted feature maps into a one-dimensional vector for classification in fully connected layers.

**F. Fully Connected Layers:** Dense layers perform high-level reasoning by combining extracted features for disease classification, while dropout regularization helps improve generalization.

**G. Output Layer:** The output layer uses the Softmax activation function to generate probability distributions for disease classes:

$$P(y = i) = \frac{e^{z_i}}{\sum_{j=1}^n e^{z_j}}$$

**H. Training Configuration:** The model is trained for 50 epochs with a batch size of 16 using the Adam optimizer and categorical cross-entropy loss function:

$$Loss = -\sum y \log(\hat{y})$$

Model weights are updated through backpropagation to reduce classification error.



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### IV. CONCLUSION AND FUTURE WORK

The proposed Dragon Fruit Stem Disease Detection system using Convolutional Neural Networks (CNN) provides an effective and accurate solution for detecting diseases from stem images. The system helps farmers identify diseases at an early stage, reducing crop damage and improving productivity. By using image preprocessing and CNN-based feature extraction techniques, the model achieves reliable disease classification with reduced manual effort. The proposed approach supports smart agriculture by providing faster, automated, and efficient disease monitoring for dragon fruit cultivation.

In future, the system can be improved by collecting larger and more diverse stem image datasets to increase detection accuracy and robustness. Advanced deep learning models such as ResNet, EfficientNet, and transfer learning techniques can be implemented for better performance. The project can also be developed into a real-time mobile or web application for easy access by farmers. Furthermore, integration with IoT sensors, cloud computing, and automated monitoring systems can enhance smart farming and enable continuous disease surveillance in dragon fruit plantations.

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