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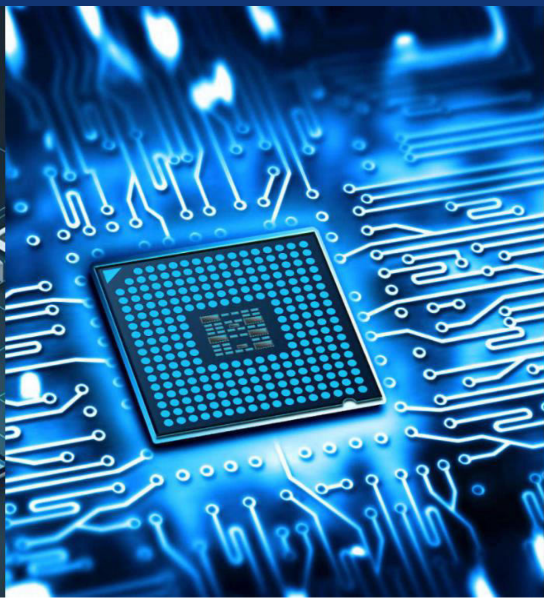


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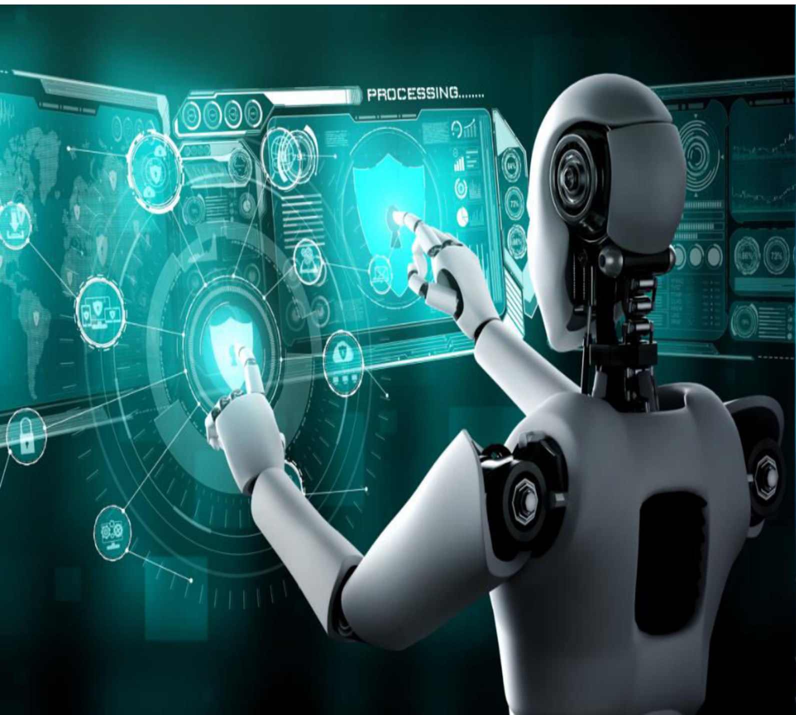

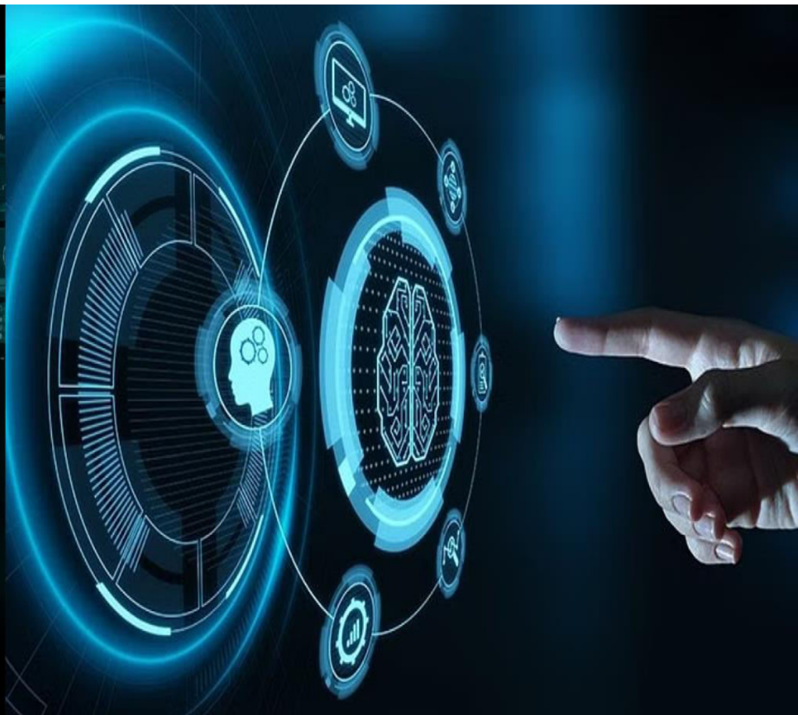

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Banana Leaf Disease Identification

Bharath D B [1], Madhusudan S P [2], Manjunath C [3], Mohammed Zeeshan [4], Thara K L [5]

Department of ISE, JNN College of Engineering, India[1]

Department of ISE, JNN College of Engineering, India[2]

Department of ISE, JNN College of Engineering, India[3]

Department of ISE, JNN College of Engineering, India[4]

Department of ISE, JNN College of Engineering, India[5]

ABSTRACT: Banana crops play a crucial role in the agricultural economy worldwide. However, various diseases such as Yellow Sigatoka and Panama Wilt significantly impact banana production, leading to reduced yield and financial losses. Traditional methods of disease identification rely on manual inspection, which is time-consuming and prone to inaccuracies. In this paper, we propose a machine learning-based approach using Convolutional Neural Networks (CNNs) to automatically classify banana leaf diseases. The system includes image preprocessing, segmentation, feature extraction, and classification to detect and categorize leaf diseases effectively. Experimental results demonstrate that the proposed model achieves high accuracy in disease classification, making it a valuable tool for farmers and agricultural experts

KEY WORDS: Machine learning, deep learning, convolutional neural networks, banana leaf disease, image processing, plant health monitoring.

I. INTRODUCTION

Banana is one of the world's most consumed fruits and is a vital economic crop, particularly in tropical and subtropical regions. However, banana plants are highly susceptible to diseases, such as Yellow Sigatoka and Panama Wilt, which cause significant yield loss. Traditional disease identification methods depend on manual visual inspection, which is subjective and inefficient. Machine learning, particularly CNNs, has emerged as a powerful tool for image-based disease detection. This study aims to develop an automated banana leaf disease detection system to help farmers diagnose infections early and take appropriate preventive measures.

II. LITERATURE REVIEW

Several studies have explored machine learning techniques for plant disease detection. Criollo et al. (2020) developed a CNNbased model for banana plant disease classification using RGB images. Their approach involved preprocessing techniques such as resizing, normalization, and augmentation to enhance classification accuracy. While effective, the study highlighted limitations in handling real-world environmental variations such as lighting changes and occlusions.

Syihad et al. (2023) employed pre-trained CNN architectures, ResNet50 and VGG-19, for banana leaf disease classification. Their research demonstrated the advantages of transfer learning, which allows models to learn from previously trained datasets, reducing the need for extensive labeled data.
However, computational costs and resource requirements posed challenges for deployment in resource-limited environments.

Rajalakshmi et al. (2024) introduced a novel deep CNN model designed for early disease detection in banana plants. Their study emphasized the importance of early diagnosis in preventing yield loss. The integration of IoT devices and mobile applications for real-time disease monitoring was proposed as a future enhancement, highlighting the need for accessible and scalable solutions for small-scale farmers.

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III. PROPOSED METHEDOLOGY

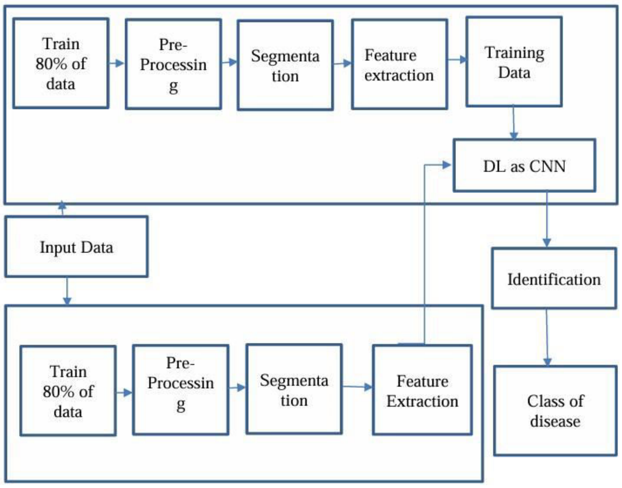

Fig 3.1 Block diagram summarizing the proposed approach for banana leaf disease identification model

3.1 Dataset Collection

A dataset of banana leaf images was collected from bananagrowing areas in Ethiopia. The dataset consists of 615 images categorized into three classes: Yellow Sigatoka (140 images), Panama Wilt (180 images), and Healthy Leaves (295 images). The images were captured under controlled lighting conditions using a 16-megapixel camera.

3.2 Preprocessing

Preprocessing involves image enhancement, noise removal, and resizing. Gaussian filtering was applied to remove unwanted noise while maintaining the edges of the leaves Images were converted to grayscale to simplify processing.

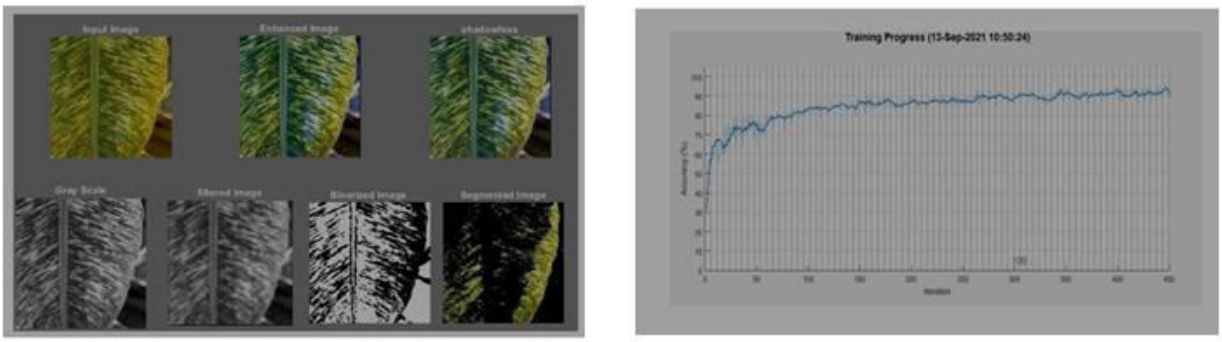

Fig – 3.2 Preprocessed Image

3.3 Segmentation

Segmentation was performed using K-means clustering to separate the diseased portions of the leaf from the healthy areas. This technique groups similar pixels together based on intensity values, aiding in effective feature extraction.

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Fig – 3.3 Segmented Image

3.4 Feature Extraction

Feature extraction was carried out using two methods: Gray Level Co-occurrence Matrix (GLCM) for texture analysis and CNN for deep feature extraction. CNNs automatically learn spatial hierarchies of features from the input images.

3.5 Classification

The extracted features were fed into a CNN classifier, which was trained using labeled data.The model uses Softmax activation to classify images into one of the three categories: Yellow Sigatoka, Panama Wilt, or Healthy.

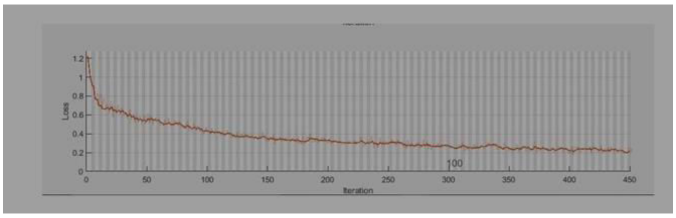

Fig – 3.4 Accuracy graph

IV. RESULTS

4.1 Experimental Setup

Software: Python, TensorFlow, Keras, OpenCV, Scikit-learn
Hardware: Intel Core i5, 8GB RAM, GPU (Google Colab for training)
Dataset Split: 80% Training, 20% Testing

4.2 Performance Evaluation

The model was evaluated using accuracy, precision, recall, and F1-score. The CNN model achieved an overall classification accuracy of over 90% on the test dataset.

Disease Type	Precision	Recall	F1-Score
Yellow Sigatoka	92%	91%	91.5%
Panama Wilt	94%	93%	93.5%
Healthy Leaf	96%	95%	95.5%

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These results indicate that the proposed CNN-based approach provides a robust solution for banana leaf disease classification.

V. CONCLUSION

In this paper, we proposed a CNN-based model for automatic identification of banana leaf diseases. The system efficiently classifies diseased and healthy leaves with high accuracy, reducing the need for manual inspection. Future work includes integrating the model into a mobile application for real-time field analysis and expanding the dataset to improve generalization across diverse environmental conditions.

VI. FUTURE SCOPE

Real-time Detection: Deploy the model on mobile and IoT devices for instant disease diagnosis.
Multi-Crop Classification: Extend the model to identify diseases in other agricultural crops.
Precision Agriculture: Integrate the system with drones and remote sensing technologies for large-scale monitoring.
Early Warning Systems: Predict potential disease outbreaks based on environmental conditions.
Farmer-Friendly Interfaces: Develop user-friendly interfaces with regional language support for better adoption.

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