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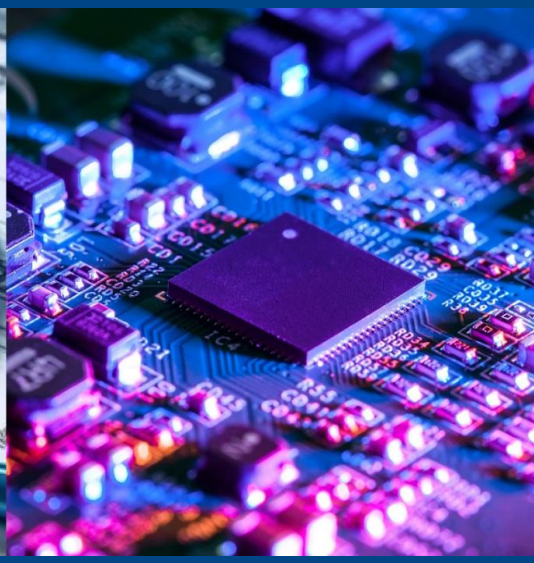

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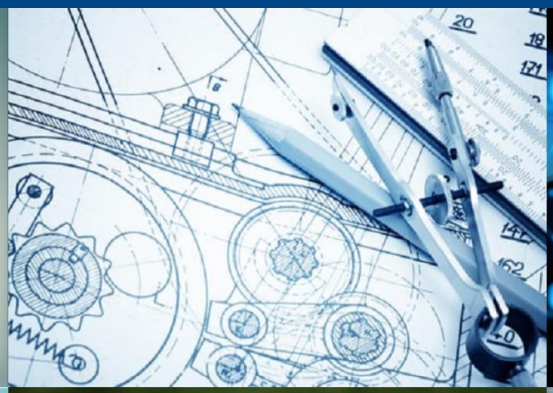

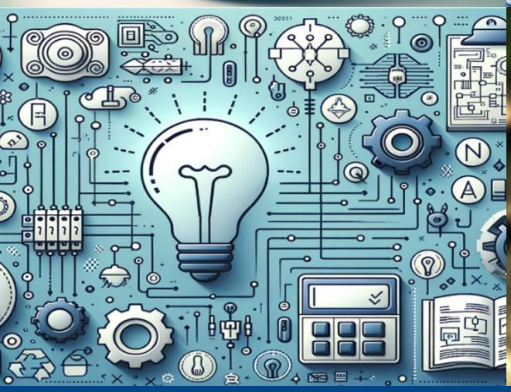

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Banana Leaf Disease Detection Using Vision Transformer

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ABSTRACT: This study presents a new method to detect banana leaf diseases using the Vision Transformer (ViT) deep learning model, which is effective at capturing long-range patterns in images. First, a dataset of banana leaf images is gathered, including both healthy leaves and those affected by diseases like Panama disease, Fusarium wilt, and Sigatoka. The images are labeled and preprocessed by resizing, normalizing, and augmenting the data to improve the model's performance A pre-trained ViT model is fine-tuned on this dataset, with the data split into training, validation, and test sets. The model is evaluated using metrics like training accuracy, training loss, validation accuracy, and validation loss to ensure it can detect diseases accurately. After achieving good results, the fine-tuned model is deployed in an application where farmers can upload images for disease detection. The system helps with timely disease identification, improving crop management. The model will be periodically retrained with new data to maintain its accuracy and adaptability.

I. INTRODUCTION

Agriculture plays a vital role in feeding the world and supporting economies, with banana farming being especially important due to the fruit's nutritional value. Bananas are rich in calcium, potassium, and iron, making them a widely consumed and healthy food. While India contributes significantly to global banana production, other major producers include the Philippines, Ecuador, Indonesia, and Brazil, and the United States is the top importer. However, the banana industry faces serious threats from diseases like black Sigatoka, Bract Mosaic, and Panama Disease, as well as pests, which can damage crops and reduce yields. To safeguard the industry, it's crucial to develop disease-resistant banana varieties, control pests, and adopt climate-resilient farming practices

II. RELATED WORK

Recent advancements in deep learning have led to the use of methods like Convolutional Neural Networks (CNNs) and Vision Transformers (ViTs) for plant disease detection. CNNs are commonly used because they can automatically extract features from images, but they may struggle to capture long-range dependencies in complex disease patterns. In contrast, ViTs handle image patches as sequences, allowing them to capture both local and global features, making them more effective for tasks like plant disease detection. Studies have shown that ViTs perform better than CNNs in handling large datasets and providing accurate results. Researchers also emphasize the importance of using comprehensive datasets and data augmentation to improve model performance, with some focusing on integrating disease detection into mobile apps to help farmers detect diseases early. ViTs, due to their ability to capture detailed patterns, show great promise for improving disease detection, especially in banana cultivation.

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III. METHODOLOGY

Data Exploration and Visualization

In this module, the necessary libraries are imported, and the dataset's basic statistics are displayed. The total number of images and classes are printed, providing an overview of the dataset's composition. Additionally, a few sample images from each class are visualized to give a glimpse of the dataset's content.

Data Preprocessing and Splitting

This module focuses on preparing the dataset for model training. The images' file paths and corresponding labels are organized into a DataFrame. The dataset is then split into training, validation, and test sets using the train_test_split function. The mapping of classes to numerical labels is defined for model training.

Model Initialization and Configuration

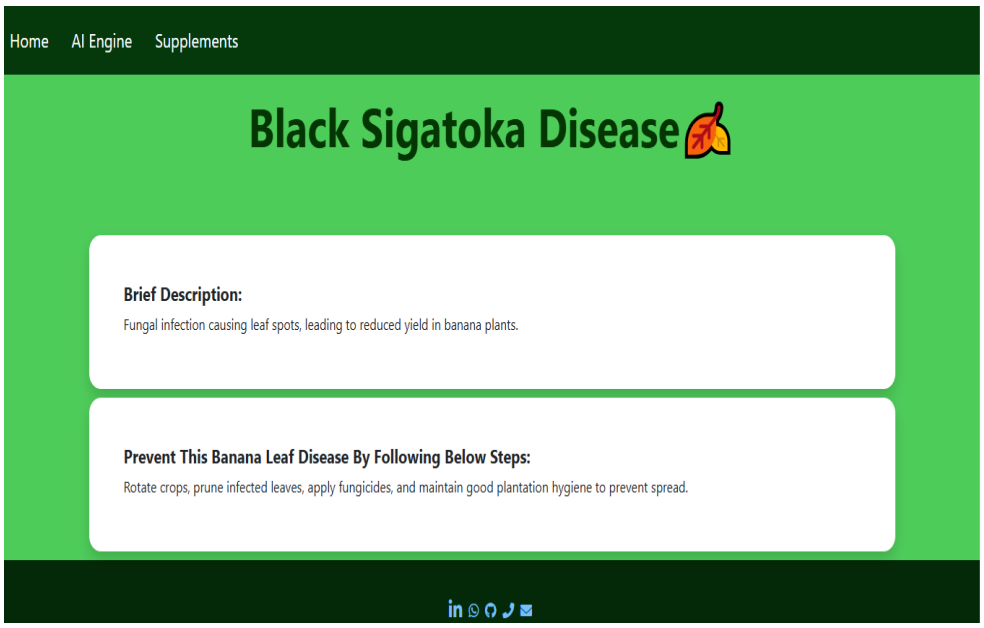
In this module, the model architecture is set up using a Vision Transformer (ViT). The model's parameters, including input size, output size, and default transformations, are configured. The ViT's encoder and projection head layers are frozen to avoid unnecessary training, and a new linear head is added for the specific classification task.

Model Training

The training process is executed in this module. The ViT model is trained on the training dataset, and its performance is evaluated on the validation set. The training loop includes loss calculation, backpropagation, and optimization. Checkpoints are saved during training to keep track of the best-performing model based on validation loss.

Evaluation and Visualization

The final module involves evaluating the trained model on the test dataset. The accuracy is computed and printed, and a confusion matrix is generated for a detailed analysis of the model's performance on different classes. Visualizations, such as loss and accuracy curves, provide insights into the model's training progress and overall performance.



IV. CONCLUSION

In conclusion, this study presents a promising method for detecting banana leaf diseases using the Vision Transformer (ViT) deep learning model. By compiling a comprehensive dataset of banana leaf images affected by various diseases and fine-tuning a pre-trained ViT model, the approach effectively identifies diseases and helps improve crop management. The model's performance is evaluated through key metrics, ensuring its accuracy before deployment. Integrated into a real-world application, the system allows farmers and agricultural experts to detect diseases early,

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supporting better crop health. Ongoing monitoring and retraining ensure the model remains accurate and adaptable over time, making it a valuable tool for sustainable agriculture.

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