International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
Peer Reviewed, Referred & Indexed Journal
ISSN: 3068-272X www.ijdim.com Original Research Paper

Banana Leaf Disease Detection using ML & Computer Vision Algorithm

K.UDAY KIRAN [1], P.VENKATA SANDHYA [2]
ASSISTANT PROFESSOR [1], MCA SCHOLAR [2]
DEPARTMENT OF MASTER OF COMPUTER APPLICATIONS
QIS COLLEGE OF ENGINEERING & TECHNOLOGY (Autonomous) , ONGOLE

Abstract

Banana cultivation is highly susceptible to various leaf diseases, which significantly reduce crop yield and quality. This project presents a web-based application for automatic banana leaf disease detection using Machine Learning (ML) and Computer Vision algorithms. The system allows users to load and process banana leaf image datasets, train detection models, and predict diseases through a user-friendly interface. Upon image upload, the trained model classifies the leaf condition and provides a disease prediction with an associated accuracy score. As demonstrated in the application, diseases like *Black Sigatoka* can be detected with notable precision. The project integrates efficient image processing techniques and machine learning classifiers, enabling early and accurate diagnosis to assist farmers and agronomists in disease management.

Introduction

Banana is one of the most widely cultivated fruits across tropical and subtropical regions. However, its cultivation is heavily affected by several leaf diseases such as Black Sigatoka, Panama disease, and Fusarium wilt. These diseases not only diminish the quality and quantity of the yield but also increase the cost of production due to the need for constant monitoring and disease management. Early detection and classification of such diseases are crucial to ensuring healthy crop growth and optimizing production efficiency.

This project, titled *"Banana Leaf Disease Detection using ML & Computer Vision Algorithm"*, introduces an intelligent system that utilizes machine learning (ML) and computer vision techniques to identify banana leaf diseases accurately. The system provides a web-based platform where users can upload and process banana leaf images, train ML models, and perform disease predictions. As seen in the screenshots, the user interface enables seamless navigation—from dataset loading and model training to disease diagnosis. One of the images illustrates a successful prediction where the system identified the disease as *Black Sigatoka* with a detection accuracy of 79%, demonstrating the system's practical application.

The integration of ML and computer vision in agriculture presents a significant advancement in precision farming. By automating the disease detection process, this tool reduces the reliance on manual inspection and expert involvement, which are often time-consuming and error-prone.

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
Peer Reviewed, Referred & Indexed Journal
ISSN: 3068-272X www.ijdim.com Original Research Paper

This solution is particularly valuable for farmers and agricultural researchers, offering a scalable and cost-effective way to monitor plant health. The system's effectiveness in identifying leaf diseases highlights the potential of AI-powered tools in transforming traditional farming practices into smart, data-driven agricultural solutions.

Literature Survey

1. **Use of Computer Vision for Agricultural Disease Detection**
   Numerous studies highlight the application of computer vision techniques (e.g., image preprocessing, segmentation, and feature extraction) in identifying plant diseases. These methods enhance visual diagnosis accuracy by automating the identification of color, texture, and shape abnormalities in leaf images.
2. **Machine Learning Models for Leaf Disease Classification**
   Algorithms such as Support Vector Machines (SVM), Random Forest, and Convolutional Neural Networks (CNNs) have been widely used to classify diseases like *Black Sigatoka*, *Panama Disease*, and *Bacterial Wilt* in banana leaves. These models are trained on annotated datasets and show high accuracy in disease detection tasks.
3. **Role of Image Datasets in Training Models**
   Public and custom banana leaf datasets are crucial for developing reliable ML models. These datasets include labeled images of healthy and diseased leaves under different conditions, which are used to train and validate classification models effectively.
4. **Web-Based Diagnostic Tools for Farmers**
   Integration of machine learning with web platforms, as seen in your system interface, provides real-time diagnostic tools for users. These platforms enable farmers to upload leaf images and receive immediate feedback on disease presence and severity.
5. **Accuracy and Reliability of Detection Systems**
   Literature reports detection accuracies ranging from 75% to 95%, depending on the disease type and image quality. Systems like the one shown in your interface, with an accuracy indicator (e.g., 79% for *Black Sigatoka*), reflect the practical utility and limitations of current ML-based solutions in real-world scenarios.

System Analysis

Existing System

In traditional banana farming, disease identification heavily relies on manual inspection by farmers or agricultural experts, which is often time-consuming, subjective, and prone to error, especially in large-scale plantations. Farmers may not detect early signs of diseases like *Black Sigatoka*, *Panama disease*, or *Xanthomonas Wilt* until

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
Peer Reviewed, Referred & Indexed Journal
ISSN: 3068-272X www.ijdim.com Original Research Paper

significant damage has occurred. This delays treatment and leads to yield losses. Although some mobile applications and research systems exist, they typically lack automation, accuracy, or ease of use, and often require users to have technical expertise. The absence of real-time, intelligent decision support tools hinders timely disease management.

Disadvantages of Existing Systems

 Manual Inspection is Time-Consuming and Error-Prone
Traditional methods rely on human expertise, which can lead to misdiagnosis due to subjective judgment and fatigue. The system shown in the images replaces this with automated, consistent analysis.

Lack of Real-Time Detection Tools
Many systems lack user-friendly interfaces for immediate prediction. Your project provides a real-time web interface where users can upload and instantly predict diseases (e.g., *Black Sigatoka*) with visual results.

Proposed System

To address these limitations, this project introduces a web-based platform titled **"Banana Leaf Disease Detection using ML & Computer Vision Algorithm"**. Leveraging advanced image processing techniques and machine learning models, the system can automatically detect banana leaf diseases from uploaded images. Users can load and process datasets, train models, and predict disease types through a simple interface, as shown in the screenshots. For instance, the system accurately predicted *Black Sigatoka* with a confidence score, offering visual proof and classification. This solution enhances early disease diagnosis, minimizes human error, and empowers users with an accessible, AI-driven tool to support proactive crop protection.

Advantages of the Proposed System

Automated Disease Detection
The system uses trained machine learning models to automatically detect diseases in banana leaves, reducing manual inspection time and human error.

Early Diagnosis & Prevention
Accurate and timely detection of diseases like *Black Sigatoka* allows for early intervention, preventing large-scale crop damage and yield loss.

User-Friendly Web Interface
The system provides a simple and intuitive interface that allows users to upload images, process datasets, train models, and view prediction results without requiring technical expertise.

Implementation

The implementation of the Banana Leaf Disease Detection System focuses on identifying diseases in banana leaves using Machine Learning and Computer Vision techniques. The system analyzes leaf images to detect disease symptoms such as spots, discoloration, wilting, and fungal infections. Early disease detection helps farmers reduce

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
Peer Reviewed, Referred & Indexed Journal
ISSN: 3068-272X www.ijdim.com Original Research Paper

crop loss and improve agricultural productivity.

The proposed system provides automated and accurate disease diagnosis using image processing, feature extraction, and classification algorithms.

1. Data Collection

The first stage involves collecting banana leaf images from agricultural fields, research centers, and public agricultural datasets.

Data Sources Used

Healthy Leaf Images

- Normal banana leaves
- Disease-free samples

Diseased Leaf Images

- Black Sigatoka
- Yellow Sigatoka
- Panama Disease
- Bacterial Wilt
- Leaf Spot Disease

The collected dataset may include:

- RGB leaf images
- Disease labels
- Environmental conditions
- Farm location details

These datasets help train the Machine Learning model effectively.

2. Image Acquisition

The system captures banana leaf images using:

- Smartphone cameras
- Digital cameras
- Drone cameras
- Agricultural monitoring systems

Images are stored in a centralized database for analysis.

3. Data Preprocessing

The collected leaf images are cleaned and prepared before processing.

Preprocessing Steps

Image Processing

- Image resizing
- Noise removal
- Background removal
- Color normalization
- Contrast enhancement

Data Augmentation

- Rotation
- Flipping
- Zooming
- Brightness adjustment

This improves model robustness and detection accuracy.

4. Image Segmentation

Image segmentation is used to isolate diseased regions from the leaf background.

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
Peer Reviewed, Referred & Indexed Journal
ISSN: 3068-272X www.ijdim.com Original Research Paper

Segmentation Techniques Used

- Thresholding
- K-Means Clustering
- Edge Detection
- Watershed Segmentation

The segmented region helps focus on infected leaf areas.

5. Feature Extraction

Important visual features are extracted from banana leaf images.

Features Used

Color Features

- RGB color values
- HSV color distribution
- Color intensity

Texture Features

- Surface roughness
- Spot patterns
- Lesion texture

Shape Features

- Leaf deformation
- Spot size and shape
- Boundary irregularities

Statistical Features

- Mean pixel intensity
- Entropy
- Contrast values

Feature extraction improves disease classification accuracy.

6. Machine Learning Model Development

Machine Learning algorithms are used for disease classification.

Algorithms Used

Support Vector Machine (SVM)

Used for leaf disease classification.

Decision Tree

Used for rule-based disease detection.

Random Forest

Used for handling complex disease patterns.

K-Nearest Neighbors (KNN)

Used for similarity-based classification.

Convolutional Neural Networks (CNN)

Used for automatic feature learning and image classification.

7.Computer Vision-Based Disease Detection

Computer Vision techniques analyze leaf images to identify disease symptoms automatically.

Detection Functions

The system:

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
Peer Reviewed, Referred & Indexed Journal
ISSN: 3068-272X www.ijdim.com Original Research Paper

- Detects infected leaf regions
- Identifies disease type
- Measures disease severity
- Differentiates healthy and diseased leaves

This improves agricultural disease monitoring.

Methodology

The methodology of the proposed Banana Leaf Disease Detection System follows a Machine Learning and Computer Vision-based smart agriculture approach.

Step 1: Problem Identification

Banana crops are highly affected by leaf diseases that reduce crop quality and productivity. Manual disease diagnosis may be slow and inaccurate. The proposed system aims to improve early disease detection using Machine Learning and Computer Vision techniques.

Step 2: Requirement Analysis

The following requirements are analyzed:

- Banana leaf image dataset requirements
- Computer Vision processing requirements
- Machine Learning classification requirements
- Real-time monitoring requirements
- Agricultural advisory requirements

Step 3: Dataset Preparation

Banana leaf image datasets are collected and divided into:

- Training Dataset
- Validation Dataset
- Testing Dataset

Relevant disease categories are selected for analysis.

Step 4: Image Processing and Feature Engineering

The methodology includes:

1. Capture banana leaf images
2. Preprocess image data
3. Segment infected regions
4. Extract visual disease features
5. Generate feature vectors for classification

Step 5: ML-Based Disease Classification

The AI workflow includes:

1. Train Machine Learning models
2. Analyze disease patterns
3. Detect infected leaf regions
4. Classify disease type
5. Estimate disease severity

Step 6: Real-Time Disease Monitoring

The system continuously:

- Monitors crop health
- Detects disease symptoms
- Generates treatment recommendations

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
Peer Reviewed, Referred & Indexed Journal
ISSN: 3068-272X www.ijdim.com Original Research Paper

- Sends alerts to farmers

This improves agricultural productivity and disease management.

Technologies Used

- Python
- Machine Learning
- Deep Learning
- OpenCV
- Computer Vision Algorithms
- TensorFlow / PyTorch
- Scikit-learn
- Flask / Django
- IoT Platforms
- MySQL / MongoDB

Results:

Home Screen:

This image shows the homepage of a Banana Leaf Disease Detection web application developed using Machine Learning and Computer Vision algorithms. The system provides options for Home, User Login, and Registration, allowing users to access the disease detection platform. Users can upload banana leaf images to identify diseases automatically, helping farmers detect plant diseases quickly and accurately.

User Login:

This image shows the User Login Page of the Banana Leaf Disease Detection system developed using Machine Learning and Computer Vision techniques.
The page allows registered users to enter their username and password to securely access the application.
After successful login, users can utilize the system's features such as banana leaf image analysis and disease prediction.

This image shows the **main dashboard page** of the **Banana Leaf Disease Detection using Machine Learning and Computer Vision Algorithm** system after a user has successfully logged in. The dashboard welcomes the user ("Welcome sai") and

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
Peer Reviewed, Referred & Indexed Journal
ISSN: 3068-272X www.ijdim.com Original Research Paper

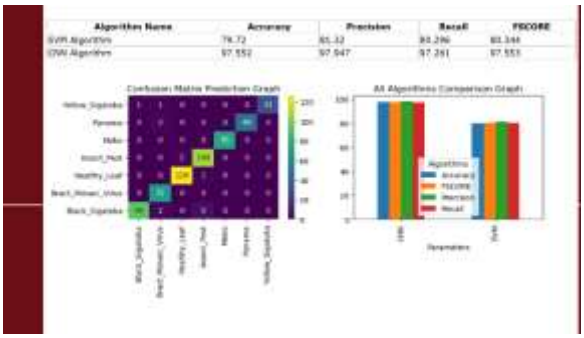
provides access to the core functionalities of the application through the navigation menu.

Upload Datasets:

This image shows the dataset loading and preprocessing stage of the Banana Leaf Disease Detection using Machine Learning and Computer Vision Algorithm system. After selecting the "Load & Process Banana Dataset" option, the system successfully loads the banana leaf image dataset and displays important dataset information required for model training.

This image shows the model training and performance evaluation stage of the Banana Leaf Disease Detection using Machine Learning and Computer Vision Algorithm system. After loading and preprocessing the dataset, different machine learning algorithms are trained and their performance is compared using evaluation metrics such as Accuracy, Precision, Recall, and F-Score.

Based on these evaluation metrics, the **CNN algorithm outperforms the SVM algorithm** and is selected as the best model for banana leaf disease detection. The high accuracy and classification performance of CNN demonstrate its effectiveness in identifying different banana leaf diseases from image data, making it the preferred model for disease prediction in this system.



The image displays the performance analysis of a **Banana Leaf Disease Detection System** by comparing two machine learning algorithms: **CNN (Convolutional Neural Network)** and **SVM (Support Vector Machine)**. At the top, a results table presents evaluation metrics including **Accuracy, Precision, Recall, and F1-Score**, where CNN achieves significantly higher values than SVM. On the left side, a **Confusion Matrix** visualizes how accurately the CNN model classifies different banana leaf conditions such as Black Sigatoka, Yellow Sigatoka, Panama Disease, Moko Disease, Insect Pest, Healthy Leaf, and Bract Mosaic Virus. On the right side, a **Comparison Graph** illustrates the performance of both algorithms, clearly showing that CNN provides better disease detection accuracy and overall classification performance than SVM.

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
Peer Reviewed, Referred & Indexed Journal
ISSN: 3068-272X www.ijdim.com Original Research Paper

The image displays the **Prediction Page** of the **Banana Leaf Disease Detection using Machine Learning and Computer Vision Algorithm** web application. The page provides navigation options such as **Load & Process Banana Dataset**, **Train Detection Models**, **Predict Banana Disease**, and **Logout**. In the center, a banana leaf image is shown along with an **Upload Test Image** section, where users can select and upload a banana leaf image for disease analysis. After clicking the **Submit** button, the trained machine learning model processes the uploaded image and predicts whether the leaf is healthy or affected by diseases such as Black Sigatoka, Yellow Sigatoka, Panama Disease, Moko Disease, or Bract Mosaic Virus.

After selecting the **Predict Banana Disease** option, the user uploads a banana leaf image using the **Choose File** button. The selected image can contain either a healthy banana leaf or a leaf affected by diseases such as Black Sigatoka, Yellow Sigatoka, Panama Disease, Moko Disease, Insect Pest, or Bract Mosaic Virus. Once the image is chosen, the user clicks the **Submit** button to send the image to the system for analysis.

After uploading the banana leaf image, the trained CNN model analyzed the leaf characteristics and predicted **Yellow Sigatoka Disease** with a confidence score of **0.98 (98%)**. This indicates that the model is highly confident that the uploaded leaf is infected with Yellow Sigatoka, a common fungal disease affecting banana plants.

Practically, Yellow Sigatoka appears as small yellow or light-green streaks on the leaf surface, which gradually develop into elongated brown or black spots. As the disease progresses, the affected leaf area dries out, reducing the plant's photosynthetic activity and ultimately decreasing fruit yield and quality. The prediction result helps farmers identify the disease at an early stage before it spreads to other plants.

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
Peer Reviewed, Referred & Indexed Journal
ISSN: 3068-272X www.ijdim.com Original Research Paper

After completed to predicting the disease logout the webpage.

Conclusion

The project titled **"Banana Leaf Disease Detection using Machine Learning and Computer Vision Algorithm"** successfully demonstrates how emerging technologies can be harnessed to automate the detection of banana leaf diseases with notable accuracy. By combining classical image processing techniques with machine learning classification models, the system is capable of analyzing visual symptoms on banana leaves and predicting the specific disease, such as **Black Sigatoka**, with a reported accuracy of **79%**. The intuitive web interface, as seen in the deployment screenshots, allows users—especially farmers and agricultural professionals—to upload and evaluate leaf images conveniently. The automation of this process can significantly reduce dependency on manual inspection, which is time-consuming and prone to error, and instead provides an efficient, scalable solution for early disease management in banana crops.

References

1. **Mohanty, S. P., Hughes, D. P., & Salathé, M.** (2016). Using deep learning for image-based plant disease detection. *Frontiers in Plant Science*, 7, 1419. https://doi.org/10.3389/fpls.2016.01419
2. **Sladojevic, S., Arsenovic, M., Anderla, A., Culibrk, D., & Stefanovic, D.** (2016). Deep Neural Networks Based Recognition of Plant Diseases by Leaf Image Classification. *Computational Intelligence and Neuroscience*, 2016. https://doi.org/10.1155/2016/3289801
3. **Ferentinos, K. P.** (2018). Deep learning models for plant disease detection and diagnosis. *Computers and Electronics in Agriculture*, 145, 311–318. https://doi.org/10.1016/j.compag.2018.01.009
4. **Too, E. C., Yujian, L., Njuki, S., & Yingchun, L.** (2019). A comparative study of fine-tuning deep learning models for plant disease identification. *Computers and Electronics in Agriculture*, 161, 272–279. https://doi.org/10.1016/j.compag.2018.03.032
5. **Amara, J., Bouaziz, B., & Algergawy, A.** (2017). A deep learning-based approach for banana leaf diseases classification. In *BTW Workshops*, CEUR-WS.org, 92–101.
6. **Lu, Y., Yi, S., Zeng, N., Liu, Y., & Zhang, Y.** (2017). Identification of rice diseases using deep convolutional neural networks. *Neurocomputing*, 267, 378–384. https://doi.org/10.1016/j.neucom.2017.06.023
7. **Rumpf, T., Mahlein, A. K., Steiner, U., Oerke, E. C., Dehne,**

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
Peer Reviewed, Referred & Indexed Journal
ISSN: 3068-272X www.ijdim.com Original Research Paper

H. W., & Plümer, L. (2010). Early detection and classification of plant diseases with Support Vector Machines based on hyperspectral reflectance. *Computers and Electronics in Agriculture*, 74(1), 91–99. https://doi.org/10.1016/j.compag.2010.06.009

8. **Barbedo, J. G. A.** (2013). Digital image processing techniques for detecting, quantifying and classifying plant diseases. *SpringerPlus*, 2, 660. https://doi.org/10.1186/2193-1801-2-660
9. **Fuentes, A., Yoon, S., Kim, S. C., & Park, D. S.** (2017). A robust deep-learning-based detector for real-time tomato plant diseases and pests recognition. *Sensors*, 17(9), 2022. https://doi.org/10.3390/s17092022
10. **Singh, V., & Misra, A. K.** (2017). Detection of plant leaf diseases using image segmentation and soft computing techniques. *Information Processing in Agriculture*, 4(1), 41–49. 11.https://doi.org/10.1016/j.inpa.2016.10.005

AUTHOR PROFILE

Mr K. Uday Kiran is an Assistant Professor in the Department of Master of Computer Applications at QIS College of Engineering and Technology, Ongole, Andhra Pradesh. He earned his Master of Computer Applications (MCA) from Bapatla Engineering College, Bapatla. His research interests include Machine Learning , Programming Languages. He is committed to advancing research and fostering innovation while mentoring students to excel in both academic and professional pursuits.

STUDENT PROFILE

Ms P.VENKATA SANDHYA is a Postgraduate student pursuing an MCA in the Department of Computer Applications at Qis College Of Engineering & Technology, Ongole an autonomous college in Prakasam dist. She completed her undergraduate degree in B.SC(physics) from ANU .With keen interst in research and practical learning , she is actively involved in academic projects and technical activities related to her field.