Beans Plant Disease Identification Using image processing

Report Draft

**Abstraction**

"Agriculture plays a vital role in sustaining human lives by providing food resources. However, the presence of infected crops significantly hinders agricultural productivity, resulting in food loss. Plant diseases pose a constant threat to both the quality and quantity of agricultural yields. Timely detection of these diseases remains a significant challenge, especially when dealing with large agricultural areas. Manual monitoring and identification of crops become impractical under such circumstances. Early transmission of diseases further exacerbates the problem.

In this paper, I propose a novel approach for efficient plant disease detection and monitoring using deep learning techniques, specifically focusing on leaf identification, disease identification using beans leaf. I leverage image processing and classification methods to automatically detect and classify plant defects based on symptoms manifested on the plant leaf. Additionally, I am exploring the use of fertilizers and pesticides to assist in disease monitoring.

My study aims to address the need for a scalable and accurate solution to monitor large crop fields and identify diseases in a timely manner. By leveraging the power of deep learning, I am providing a robust framework for automated plant disease detection, which can significantly improve agricultural practices and mitigate crop losses. The proposed approach has the potential to revolutionize the agricultural industry by enabling proactive disease management and optimizing resource allocation.

Through extensive experimentation and comparative analysis of various deep learning models, including CNN, RNN, VGG16, and the Transformer model, I evaluated the effectiveness and efficiency of each model in terms of disease detection accuracy and computational complexity. The results shed light on the strengths and limitations of each model, providing valuable insights for future research and practical implementation.

Overall, my research contributes to the field of plant disease detection by proposing an advanced and scalable solution that combines image processing, deep learning, and agricultural practices. The findings offer a promising direction for improving crop management and ensuring food security in a sustainable manner.

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1. **LIST OF ABBREVIATIONS**

| **Term** | **Definition** |
| --- | --- |
| UI | User Interface |
| RGB | Red Green Blue |
| SVM | Support Vector Mechanism |
| KNN classification | K nearest neighbor classification |
| HSV | Hue Saturation Value |
| OpenCV | Open Computer Vision is an open source library for image processing |

# INTRODUCTION

## 1.1. Background Context

Agriculture is the most important sector for the Sri Lankan economy. This sector is the only thing which provides the essential needs of people. The majority of the labor force engaged in this sector.

In the agriculture sector there are many unsolved problems related to crop cultivation. The planters are facing lots of problems to get output of the cultivation as effectively. So they have to follow some crop protection techniques. Crop protection means the collection of practices farmers use to defend their crops against virus, insects, disease.Most of the people don’t know what type of soil is good for their plants. Even though they selected the proper soil type, they don’t know how to protect their plants from disease. Insects and diseases have catastrophic consequences on food production. Therefore the planters have to find the very best solution or pesticides to protect their plants. And also they have to monitor the plants every time perfectly after usage of that specific pesticide. If that causes an adverse effect then they should stop that usage and need to find another solution alternatively.

Nowadays modern agriculture would be the primary active ingredient in the Roundup brand of agricultural herbicides, genetically modified organisms (GMOs), agricultural biological such as microbial, glyphosate. These help farmers to increase yield and reduce the natural resources.

Identifying nutrition deficiency is the most important thing for cultivation. Can identify the nutrient deficiency of the plant using the plant leaf. But some planters can’t identify that so they have to get proper advice from an agricultural person. Color changes will happen because of a lack of nutrition. according to the color changes of the Leaves. They would be able to identify particles and suggest the suitable fertilizer to the crops. The type of fertilizers can be broadly nitrogen, phosphorus, and potassium fertilizers.The Straight fertilizers which contain only one of the nutrients. A compound fertilizer which contains two or more nutrients. A complex fertilizer which is formed by mixing ingredients that react chemically. A low level fertilizer product contains a low percentage of nutrients.

Most of the farmers are engaging in the farming with the knowledge gained through the previous experience and from other farmers. Because of this improper guidance they are facing the loss in the productivity of agriculture and when the plant is affected by any diseases they are using the pesticides (without any acknowledgement) to increase the outcomes which are harmful to the beings which are consuming it in the term of decreasing. If all agricultural activities want to happen properly then he wants to meet and get advice from the agricultural professionals. What if he can solve the problems from the home and get solutions for increasing the productivity of agriculture?

So, This system provides solutions for farmers. The proposed system could identify a leaf using the shape, nerve and color it possesses. After it has been identified, the system analyzes the leaf whether it has been affected by disease or not. The system identifies the leaf using the shape of the bitten type and using the symptoms of the leaf. According to the result, the system suggests some pesticides in order to cure the disease or to kill disease.If it is mal-functioning, the system suggests alternative pesticides to cure the disease. Depending on the results, the system includes an additional facility to identify nutrition symptoms problems which means some leaves turn out to be unhealthy because of nutrition problems. It is difficult to handle non-expert farmers. However, I try to find out the solutions easily for bean plants

## 1.2 Background Literature

This research, plenty of researchers present a brief survey of approaches on plant disease nutrient deficiency and disease attack detection using the image processing and machine learning techniques. This section discusses the conclusion drawn from the research papers from the earlier researcher related to the topic.

This research paper of detection of plant disease [1].This proposed system provides a new perspective in detection of the disease of plant.The two main features of plant disease detection using machine-learning methods that must be achieved are speed and accuracy. Hence there is a scope for working on development of innovative, efficient & fast interpreting algorithms which will help plant scientists in detecting disease. Work can be done for automatically estimating the severity of detected disease.

In 2013 [2], the study proposed a paddy disease identification method in Indonesia in order to increase the quality and the quantity of rice production using texture analysis with a fractal descriptor based on Fourier spectrum. In their proposed method, initially the affected paddy leaves are collected for each category of disease. Then, the lesion area was cropped manually from all leaves. Each lesion image is converted into HSV color space. Later, the saturation components are extracted, and the histogram equalization is applied and the images are sharpened using Laplacian filters.Moreover, the fractal descriptors are extracted from each lesion image and the classification is performed using probabilistic neural networks (PNN). This technique is achieved at least 83.00% accuracy in identifying the diseases using fractal descriptors.

Sandeep Kumar et. al. [3] presents a method for identification of medicinal plants based on some important features extracted from its leaf images. This paper presents an approach where the plant is identified based on its leaf features such as area, color histogram and edge histogram. Experimental analysis was conducted using some medicinal plant species.The findings indicate that the aforesaid method is a simple and an efficient attempt. The methodology here gives the identification of medicinal plants based on its edge features. The color image was converted to its corresponding grayscale equivalent image. From this grayscale image, the area of the leaf, color histogram and edge histogram using Canny edge detection algorithm are calculated. First the images of leaves were obtained. Both the test image and the database image were converted into scale. The area of the leaf was calculated using pixel count and the difference in area was found. Then the Canny edge detection method was applied and the edge histogram was analyzed for both the images. The red plane, blue plane and green plane were extracted from both the test image and the database image. The difference between the color histograms for the test and database image was observed. The average difference in area, edge histogram, and color histogram were found. Least value between the test and database image was the identified leaf. The accuracy of the algorithm was detected by different leaf images. The exceptional case was Tulsi which was wrongly identified as mint and vice-versa. The leaf characteristics vary widely from its tender stage to the mature stage. Therefore, the above algorithm is limited for images of mature leaves of a plant. Moreover, white background was maintained both for the database and test images.

R. Janani et al. [4] proposed a method for the extraction of shape, color and texture features from leaf images and training an artificial neural network (ANN) classifier to identify the exact leaf class. The key issue lies in the selection of proper image input features to attain high efficiency with less computational complexity. They tested the accuracy of the network with different combinations of image features. The tested result on 63 leaf images revealed that their method gave the accuracy of 94.4% with a minimum of eight input features. Image processing and neural network tool boxes were used in MATLAB to implement the work.

In 2015 [5], thsteps were conducted. Image segmentation technique is used to detect e approach on image segmentation, feature extraction and classification of infected parts of leaf by using K-means clustering based on the paddy leaf image and feature extraction phase derives. Artificial Neural Network is used as the classifier by the researcher. Images for sampling were taken from the internet and some of the images were manually captured using a digital camera and the images are stored in JPG format After segmenting the images, different features were extracted to provide as the input for the Artificial Neural Network. They have adopted the discrete wavelet transform (DWT) and gray level co-occurrence matrix (GLCM) method. Back propagation neural network (BPNN) was used for the classification as well. Here, the number of inputs to the neural network is equal to the number of texture features.Mainly the researcher has used MATLAB to load testing and training data files and the classifier is trained using train files to perform the classification which the researcher used in the test file.

[6]The study focuses on a new technology for classification of diseased paddy plants using global contrast enhancement. The particular technology is developed using MATLAB and tested on different images. For that, they have studied two classification techniques for paddy plant diseases. One of the significance of this study is that the researchers have looked for a fast, automatic, less expensive and accurate method to detect plant disease cases. Further, they have examined the applicability of broadband high spatial- resolution ADAR remote sensing data to detect rice sheath blight and have developed an approach to further explore the applicability of it. According to the methodology, this study can be considered as a comparative study since the researchers have compared two segmentation methods/techniques to detect paddy plant diseases. In the first method which is segmentation using normalized cuts, they have observed that spots with minimum differences are difficult to extract. Hence, they have not given any importance to the angle of image in segmentation focusing only on cost reduction. Moreover, they have observed that deciding the difference between spot color and boundary color is difficult only through the texture analysis technique. After this comparative study, it was decided that texture based approach is far better since it does not lose anything to reduce cost factor. With the observations of the comparative study, they have developed the proposed new technology using the image equalization method. Finally, it can be concluded that the proposed new technology is able to normalize the Page | 11 color vector space in order to let the region to grow easily and to segment the image with low computational time

## 1.3. Research Gap

There is some research that has been conducted to identify the leaf of the crop, and disease of that but there is Those are focusing only on the disease of the plants. Those are not suggesting any solution for the crops to cure the diseases and some of are even suggested pesticides but they are not going to monitor the plants after the usage of the pesticides.

There are several types of research to identify the diseases and Leaves of crops by using image processing but this system is using both image processing and deep learning.The classification and image recognition of disease are of major technical and economic importance in the agricultural industry. The system mainly focuses on bean plants. These several diseases are currently attacking beans. Identify new type disease`s research is not yet done image processing or machine learning. So the system is going to identify leaves of the crops after that system is going to identify the disease by using image processing. According to that disease the system suggests suitable solutions.

## 1.4. Research Problem

This research is proposed to develop a system which provides solutions for farmers specially beans cultivation. The proposed system could identify a leaf using the shape, nerve and color it possesses. After this is detected, the system analyzes whether the leaf is infested with diseases or not. The system identifies the leaf using the shape of the bitten type and using the symptoms of the leaf. As a result, the system suggests certain pesticides to cure or kill the disease Insects. Mostly use pesticides to reduce infection from the affected leaf. Depending on the results, the system suggests the disease is recovered or not. However, I try to find out the solutions easily for bean plants.

## 1.5. Research objectives

The proposed system “Identification of bean plant disease using image processing” aims to improve the livelihood of bean plants through accurate disease detection and plant monitoring. Every stage recommends organic and inorganic pesticides,fertilizer for bean plants. mainly at the early stage of plant life cycle.An Achieving efficient use of fertilizers and pesticides by monitoring the plant after spraying. For the recovery on a step-by-step basisThe system works on an android device and finds the solution on the spot. Its will reduce plant maintaining cost and expertise consulting cost

finally, at the stage of quickly thinking about what the system can deliver to the end user. Then my thought is above fundamental ideas through sharpening the agriculture knowladge and the modern topic of information technology.

Along with the main objective I’m also proposing a manual based approval from the famers to ensure my system outcomes are truly without any doubt for farmers in their stand points of way.

### 1.5.1. Specific objectives

Based on use of bean leaf for disease detection, here are some specific objectives that I can include in this study :

1. To develop a comprehensive dataset of bean leaf images, encompassing various “healthy” leaves and leaves affected by different diseases such as “ angular\_leaf\_spot', 'bean\_rust',

2. To implement and compare multiple deep learning models, such as CNN, RNN, VGG16, and Transformer, for accurate classification of bean leaf diseases.

3. To fine-tune hyperparameters of the deep learning models and evaluate their impact on disease detection performance.

4. To investigate the effectiveness of image augmentation techniques, such as rotation, zooming, and flipping, in improving the robustness and generalization of the models.

9. To propose recommendations for the practical implementation and integration of the developed models into existing agricultural systems, facilitating early disease detection and informed decision-making for farmers.

10. Get the Suggestions from the agriculture department officer for suggested pesticide and fertilizers

By addressing these specific objectives, in my study will provide a detailed analysis of the application of deep learning models in bean leaf disease detection and offer valuable insights for both the scientific community and agricultural practitioners.

# 2. Methodology

## 2.1 Methodology

The methodology employed in this research involves the use of deep learning models for the detection and classification of bean leaf diseases. Specifically, the performance of four different models, namely CNN, RNN, VGG16, and Transformer, is compared to assess their effectiveness in disease identification.

An The client side of the application is the web application for user interaction with the system which requires an image to be uploaded and sent to the server processes.Image processing involves a series of steps

## 2.1.1 Data Acquisition

In the inception stage of the research project, To gather the necessary data for training and evaluation, visits were made to various bean gardens in springvalley and welimada, capturing images of diseased and healthy bean leaves. The collected dataset consists of a sufficient number of images to enable meaningful analysis and model training.

2.2 Model Architecture and Training:

## 2.2.1 Image Preprocessing:

The acquired leaf images undergo preprocessing steps to enhance their quality. These steps include background removal, resizing, and noise reduction, ensuring consistent image dimensions and reducing unwanted artifacts

#### **2.2.2.1 Image Acquisition**

The affected leaf image was captured using the android mobile camera and uploaded to the system. Specify the specific preprocessing techniques applied to enhance the image quality, such as background removal, resizing, and noise reduction.

#### **2.2.2.2 Segmentation**

#### **2.2.2.3 Feature extraction & Classification**

After the segmentation the targeted regions features are extracted using techniques feature extraction methods are Skewness Asymmetric degree of pixels distribution in the specified window around its mean

m n

𝑚 = 1 /𝑚𝑛 ∑∑𝑝(𝑖,𝑗)

𝑗=1 𝑖=1

𝑚 𝑛

𝑚 = 1 𝑚𝑛 ∑∑( 𝑝(𝑖,𝑗) − 𝑚/ 𝜎 ) 3

𝑗=1 𝑖=1

Different intensity value between the neighborhood pixels

𝐶 = ∑ (𝑖 − 𝑗) 2 𝑖,𝑗 𝑃(𝑖,𝑗)

After extracting the features from the affected leaf image the component uses a deep learning algorithm and the technique to extract the image model. Therefore the image model has dependencies on external libraries. Tensorflow is a library used for handling machine learning algorithms such as convolutional neural network (CNN) algorithms. It is used for image classification like identifying healthy leaves or unhealthy leaves. Neural networks (CNN) algorithm learns the complex image by small layers. There will be many layers for an image. Moreover, the keras used deep neural networks, likely Tensorflow. Trained image model has 1000 dataset for each disease affected of the plant

#### **2.2.2.4. Testing the features using selected techniques**

In this phase the final process in selecting the most appropriate classifier among the SVM classifiers, CNN. So, at the end of the research comparing with the percentage of the accuracy, the better classifier is being suggested with the above mentioned algorithm. As well literature review base 6 D selection of most appreciable classifier also could be applied with the extracted features. So, either practically or analytically a most preferable with more accurate classifier will be selected

#### **2.2.2.5. Image comparison using OpenCv for plant monitoring**

The proposed system needs to compare leaf images whether the leaves are still affected by diseases or not. Use the OpenCv which can find the changes of the images. SIFT is the method of OpenCv which gets the key points of the images. The system needs to compare those key points therefore it uses the KnnMatch method of OpenCv which compares key points of the images and gets the good points. According to the number of good points, the system can predict the similarities of the images. Then the system can easily find the solution for the affected leaves.

# 3.RESULTS & DISCUSSIONS

## 3.1 RESULTS

detection results

Final output of the research project on implementing mobility and android platform based application..it is an executable APK file which can install on android devices. A single app with multi-finalities includes.

Identify insect attack

Recognize disease

Suggest pesticides and fertilizer

Get support from agro expertise

## 3.2 DISCUSSIONS

# 4 CONCLUSION

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