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# Sugarcane Disease Detection

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**ABSTRACT:** Farmers choose to cultivate sugarcane because of the good conditions for its growth. Sugarcane is closely related to the sugar sector and has a significant impact on the economies of several nations, including Brazil, India, China, and others. Of all the crops farmed for commercial purposes, sugarcane has the highest output value. Contrarily, a variety of illnesses can impair the crop's quality and productivity. The primary crop used to produce sugar and ethanol in the globe is sugarcane. If sugarcane illnesses are not treated and diagnosed early, they can spread to other crops and cause them to die, costing small-scale farmers money. This is an issue for the sugar business. Farmers can find some of these by visually examining the leaves. However, the majority of infections go undiscovered, costing farmers a great deal of money. To help reduce the harm caused by an infestation, it is essential to determine its kind. The rationale for undertaking this, was the rapidly expanding classes of illnesses and farmers' insufficient knowledge of disease identification and recognition. A solution to this issue is provided by machine learning using computer vision employing deep learning techniques.

**KEYWORDS:** Sugarcane, Farmers, Illnesses, Infestation, Productivity, Ethanol.

## I. INTRODUCTION

Worldwide, sugarcane is a significant crop that is grown for its high sugar content. However, sugarcane leaf disease, a frequent issue that affects the plant's leaves and inhibits photosynthesis and plant growth, is a problem. In order to stop the disease's spread and reduce crop loss, it is essential to identify sugarcane leaf disease early and correctly. Currently, visual inspection by farmers is the most popular method for spotting sugarcane leaf disease, but it is time-consuming, subjective, and frequently inaccurate. The identification of sugarcane leaf disease can be automated and accurate with the application of cutting-edge technology like computer vision and machine learning. This project aims to develop an efficient and reliable system for sugarcane leaf disease detection using computer vision and machine learning techniques. The proposed system will use image processing algorithms to extract features from the images of sugarcane leaves, and machine learning models will be trained to classify the disease into various categories based on the extracted features. The system will be designed to be user-friendly and accessible to farmers and agricultural professionals, enabling early detection and timely preventive measures. By offering an automated and precise solution for sugarcane leaf disease diagnosis, the suggested technology has the potential to revolutionise sugarcane production. In the long run, it can support sustainable agriculture and food security by assisting farmers in taking timely action to stop the disease's spread and reduce crop loss.

## II. RELATED WORK

Due to its high sugar content, sugarcane is an important crop that is grown all over the world. However, sugarcane leaf disease, a frequent issue that affects the plant's leaves and inhibits photosynthesis and plant growth, is a problem. Different fungus and bacteria that the disease is caused by can spread quickly, resulting in a significant loss in production and quality.

Currently, farmers typically identify sugarcane leaf disease by subjective and time-consuming visual inspection. To stop the disease's spread and reduce crop loss, early discovery is essential. As a result, a system that can accurately and quickly diagnose sugarcane leaf disease must be effective and trustworthy.

### Statement of the problem

Due to its high sugar content, sugarcane is an important crop that is grown all over the world. However, sugarcane leaf disease, a frequent issue that affects the plant's leaves and inhibits photosynthesis and plant growth, is a problem. Different fungus and bacteria that the disease is caused by can spread quickly, resulting in a significant loss in production and quality.



Currently, farmers typically identify sugarcane leaf disease by subjective and time-consuming visual inspection. To stop the disease's spread and reduce crop loss, early discovery is essential. As a result, a system that can accurately and quickly diagnose sugarcane leaf disease must be effective and trustworthy.

### III. METHODOLOGY

We opted to employ the Transfer Learning approach with the help of DenseNet 201 Convolutional Neural Network and Support Vector Machine after studying several papers on disease identification. The diseased sugarcane leaf can be found using the technique.

The DenseNet201 architecture was used to put the Transfer Learning technique into practise. Support Vector Machine (SVM) was integrated into the model's final layer in order to increase its accuracy. The accuracy was 98%, while the validation accuracy was 97.78%.

A pre-trained model is utilised as the foundation for a new machine learning job in the machine learning technique known as transfer learning. Transfer learning enables the model to use knowledge learned from a prior task or dataset to improve its performance on a new task without of having to start the learning process from scratch.

Dense connection serves as the foundation for the architecture of DenseNet201. Each layer in conventional CNN designs is solely connected to the one below it. In contrast, the connectivity pattern of DenseNet201 is dense, with every layer connected to every layer before it. Due to the network's dense connectedness, information may move more effectively throughout it and the model can learn more complicated characteristics with less input parameters.

Each of the dense blocks that make up DenseNet201 has many convolutional layers that are tightly coupled to all of the layers in the block before it. Before the convolutional layers, each dense block additionally has a bottleneck layer that limits the amount of input channels. A batch normalisation layer and a rectified linear unit (ReLU) activation function are placed after the bottleneck layer. A strong and efficient method for attaining high accuracy in plant disease identification is the transfer learning strategy, which uses the Densenet 201 architecture and SVM algorithm. The fundamental architecture for this method is a pre-trained deep learning model called Densenet 201. From a sizable collection of natural photos, the pre-trained model has already mastered the recognition of a variety of attributes. The model is composed of numerous layers, with the earliest layers capturing more fundamental elements like edges and textures and the latter ones capturing more intricate features like forms and patterns. The final layer of the model is replaced with a new fully connected layer that is trained on the dataset of sugarcane leaves for feature extraction in order to adapt the pre-trained model to the job of identifying sugarcane leaf disease. The transfer layer is the name of this new layer. The risk of overfitting is decreased since the transfer layer can be trained with little data by freezing the weights of the prior layers. An SVM algorithm is then used to classify the collected features into groups for healthy and sick tissues.

The ideal hyperplane that divides the two classes with the greatest margin is what the SVM algorithm seeks to identify. In other words, the algorithm looks for a line that divides the healthy and diseased classes while maximising the distance between them. By transforming the input characteristics into a higher-dimensional space where a linear border can be established using a kernel function, the SVM technique is also capable of handling non-linear boundaries.

A test dataset is used to assess the model's performance. To improve the performance of the model, the hyperparameters of the SVM method, such as the cost and regularisation parameters, can be adjusted. Metrics like precision, recall, and F1 score are examples of metrics that are used to assess the model's correctness.

The model was able to extract significant characteristics from the dataset of sugarcane leaves by utilising the pre-trained Densenet 201 model, which increased classification accuracy. The healthy and diseased categories could be successfully separated using the SVM algorithm, which increased classification accuracy.

The application of this strategy could help manage diseases in agriculture more effectively and efficiently. Increased crop yields and reduced economic loss can result from farmers taking adequate action to stop the spread of sugarcane leaf diseases as soon as they are identified. In general, the transfer learning method based on Densenet 201 architecture and SVM algorithm for sugarcane leaf disease identification is a promising method for identifying sugarcane leaf



diseases that can be applied to a wide range of crops and diseases, allowing for more effective and efficient disease identification in agriculture.

#### IV. EXPERIMENTAL RESULTS

The transfer learning approach using DenseNet201, Adam optimizer, and SVM achieved a test accuracy of 98% and validation accuracy of 97.78% for the Sugarcane Leaf Disease Identification. This is a very promising result, as it indicates that the model is able to accurately identify sugarcane leaf diseases with a high level of confidence.

Comparing this approach with other algorithms, it would be helpful to have more information on which specific algorithms were used and what their respective test accuracies were. However, in general, transfer learning has been shown to be a very effective approach for image classification tasks, particularly when working with limited amounts of labeled data. DenseNet is a deep learning architecture that has also shown strong performance on image classification tasks. The use of Adam optimizer can help improve the training process by dynamically adjusting the learning rate during training, which can help the model converge more quickly and improve accuracy. SVM is a commonly used classification algorithm that is particularly effective for binary classification problems, such as this one. Comprehensively, it appears that the combination of transfer learning with DenseNet201, Adam optimizer, and SVM was a good choice for the sugarcane disease identification project, and achieved excellent results.



Figure 5: Image Dataset after enhancement and Cropping to specific ratio

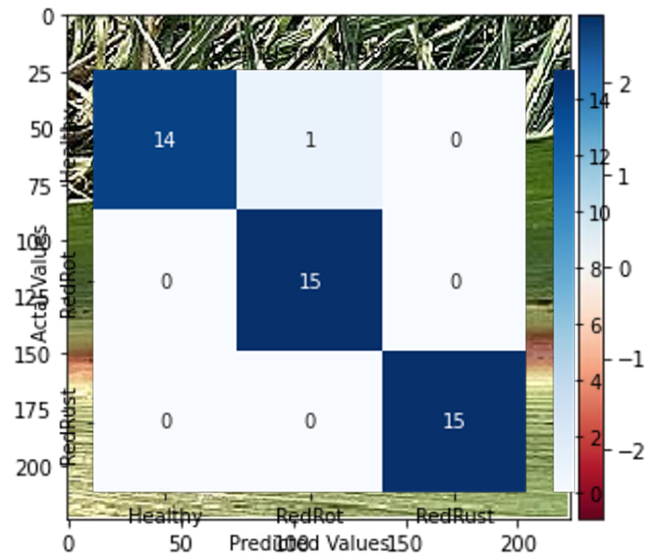


Figure 2: Confusion Matrix for training

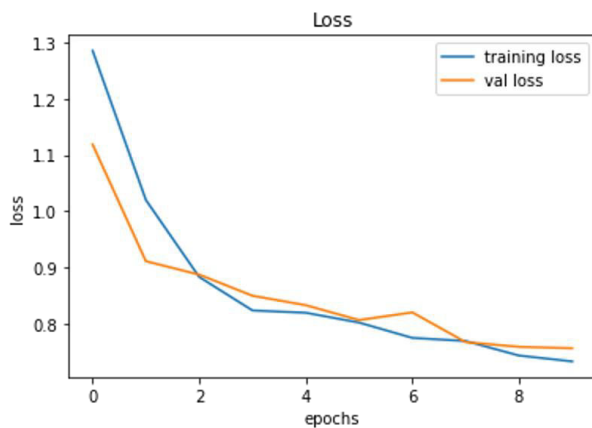


Figure 3 : Loss Graph for training model

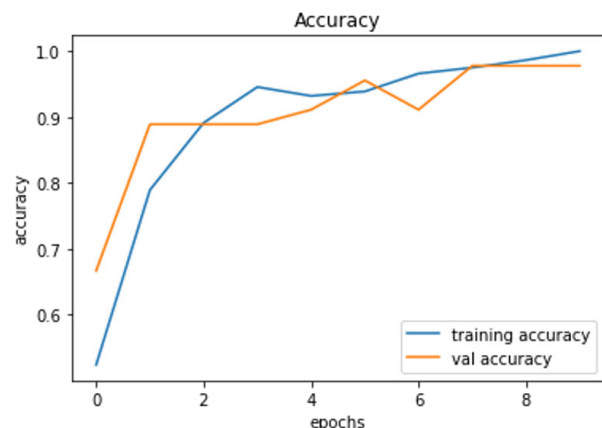


Figure 4 : Accuracy Graph for training



## V.CONCLUSION

Sugarcane Diseases are a leading cause of sugarcane crop death in India and throughout the world, thus using a promising technology like machine learning to forecast diseases early on would have a significant influence on society. Early diagnosis of this may help with decisions on alterations to high-risks faced by Sugarcane producers, which in turn may lessen difficulties. This might be a significant development in the field of Sugarcane production and agriculture. Each year, there are more and more farmers who are afflicted because of red rot and red rust disease found in their sugarcane cultivation. This calls for an early diagnosis and course of action. The cultivators stand to gain significantly from the use of appropriate technical help in this area. SVM and DenseNet 201 are two machine learning algorithms that were utilised in this study to evaluate performance. The dataset of features comprises the anticipated factors that cause red rot and red rust diseases in sugarcane, and significant characteristics that are crucial for assessing the system were chosen from them. If all the features are taken into account, the user receives a less efficient system for analysis. Attribute selection is carried out to improve efficiency. In this case, n characteristics must be chosen in order to evaluate the model that provides more accuracy. Some dataset characteristics have virtually equal correlations, thus they are eliminated. The efficiency significantly declines if all the attributes in the dataset are taken into consideration. Sugarcane Disease Detection model is developed after one of the deep learning architecture DenseNet 201 for achieving better accuracy. The goal is to use a range of evaluation tools that may accurately forecast the disease, such as the confusion matrix, accuracy, precision. When all these are used together, Sugarcane Disease Detection Model has the highest accuracy (98%).

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