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SURVEY ON COTTON PLANT DISEASE DETECTION

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Abstract - *Cotton is one of India's most important cash crops and has been a major contributor to the country's economy for decades. According to the Ministry of Agriculture and Farmers Welfare, cotton contributes to about 5% of India's total agricultural GDP and 2.5% of the country's overall GDP. Cotton is a major source of employment for millions of people, particularly in rural areas, where cotton cultivation is the main source of income. According to the Cotton Corporation of India, cotton cultivation provides employment to approximately 6.00 million farmers and 40.00 million farm laborers. Cotton plants are susceptible to several diseases that can significantly reduce crop yield and quality, resulting in substantial economic losses for farmers.*

Therefore, timely and accurate detection of these diseases is crucial to prevent their spread and minimize economic losses. Modern technologies and techniques can help farmers identify the signs of disease in the crop even before visible symptoms appear. Early detection can help farmers to identify the specific disease affecting their crops and take timely action to minimize their losses.

The use of CNN and image processing in disease detection use features extracted from the plant's leaf images to accurately diagnose specific diseases. The use of these models can help farmers take immediate action to prevent further spread of the disease. However, these models have the potential to revolutionize cotton farming in India, helping farmers improve their crop yield, quality, and overall economic well-being.

Key Words*: *Dataset, Deep Learning, Image Processing, CNN, RESNET-50, Disease Detection,Feature Extraction

I. INTRODUCTION

Cotton farming is an important sector of agriculture in India, with a long history dating back to ancient times with a diverse range of varieties grown across different regions of the country. Cotton is an important crop for many farmers in India, especially those in the central and southern parts of the country. Cotton farming in India is characterized by a mix of large-scale commercial farms and small- holder farms. Over the years, Indian cotton farmers have faced a number of challenges, including pest and disease outbreaks, market fluctuations, and environmental degradation. However, through innovative farming practices, research and development and the government support, the sectorhas continued to thrive, contributing to the country's economic growth and development. Therefore, the paper introduces and examines whether CNN model and image processing techniques can accurately detect and classify cotton plant diseases, which can ultimately help to improve crop management and prevent yield losses.

II. AIMS & OBJECTIVES

The aim of developing a cotton plant disease detection model using CNN, ResNet, image processing is to provide an accurate, reliable, and efficient method for detecting and diagnosing diseases in cotton plants.

The main objectives of the model are as follows:

1. Early Detection: The model aims to detect the presence of diseases in cotton plants at an early stage, allowing for timely intervention to prevent further spread of the disease and minimize crop losses.

2. High Accuracy: The model aims to achieve a high level of accuracy in disease detection, ensuring that the results are reliable and can be used by farmers and researchers to make informed decisions about plant health.

3. Scalability: The model should be scalable and able to process large datasets of images quickly and efficiently, enabling it to be used in large-scale agricultural applications.

4. User-friendly: The model should be user-friendly and easy to use, with a simple interface that enables farmers and researchers to upload and analyze images of cotton plants with minimal training.

5. Versatility: The model should be versatile and able to detect a wide range of diseases in cotton plants, including both common and rare diseases.

Overall, the cotton plant disease detection model aims to provide a powerful tool for improving crop management and reducing the impact of plant diseases on cotton production.

III. LITERATURE SURVEY

1. **Navina Pandhare and Vrunali Panchal, Shivam S. Mishra and Mrs. Darshna Tambe (2022)** study on Cotton leaf disease detection using deep learning. This paper presents a state-of-the-art approach to deep Convolutional Neural Network (CNN) models and image processing for plant disease recognition and classification. Here, the real-time dataset contains images of various cotton diseases, which are used for training and testing. A Convolutional Neural Network to train the model. Image processing techniques for feature extraction, image classifications. However, this system requires high implementation and has computational complexity as less accurate results are produced.

2. **Rajani Zambare, Rashmi Deshmukh, Chetan Awati, Suresh Shirgave, Sandeep Thorat, Sheetal Zalte (2022)** studied on Deep Learning Model for Disease Identification of Cotton Plants. The proposed study presents a Convolutional Neural Networks model to solve the problem of the identification of diseases in cotton leaves, it uses real-time data set containing images of cotton leaves from a Kaggle web- based data science environment.In the model initially, the images are reprocessed and segmented based on their characteristics and quality with the help of the standardization method and image is compressed. The SoftMax function is applied to get the classification of the image. The model accuracy is obtained for classification is 99.38%. However, the application has to be developed for the farmers by using intelligent devices with disease detection features.

3. **Muhammad Suleman Memon, Pardeep Kumar, Rizwan Iqbal (2022)** studied on Meta Deep Learn Leaf Disease Identification Model for Cotton. Dataset was trained on custom convolutional neural networks (CNN), VGG16, Transfer Learning and ResNet50. First the CNN model was trained, and pre-trained models such as VGG16, ResNet50 and Inception V3 were trained. At the end, multiple models were combined together using the ensemble approach. The final model was again trained on the cotton dataset. The data was collected first, and then the undesired noise was eliminated from the photos. The proposed model has outperformed the Cotton Dataset with an accuracy of 98.53%. However, the model can be further improved with regard to processing low resolution images and by reducing the size of the model. This will help with deploying the model on mobile devices.

4. **Rahul Mhatre and Vishal Lanke (2021)** studied Cotton Leaves Disease Detection and Cure Using Deep Learning. They used Image processing techniques and classification techniques are used to identify cotton leaf diseases. Factors such as color, shape and texture are useful in pattern recognition, classification, free accuracy and errors are calculated. This approach can remarkably support disease detection. However, diseases are detected by calculating only affected leaf area which leads to less accurate results because of the lack of factors used for detecting the diseases. This system also recommended the use of pesticides which could harm the soil in the long run.

5. **Varun Suryawanshi and Yash Bhamare, Rahul Badgujar and Komal Chaudhary, Mr. Bhushan Nandwalkar (2021)** studied on Cotton Leaf Disease Detection using CNN. Tensor Flow framework CNN model for identification of plant diseases and the image processing techniques are used in this study. The Data augmentation performed using MATLAB and if the images have more than one object then CNN recognizes the edges and also classifies the images accordingly. This system helps the Indian farmers for detection, identification of cotton crop diseases as it provides efficiency and required accuracy. However, this method will only show the result of cotton leaf disease if other leaf input images are provided rather than cotton leaf then it displays the result between defined disease classes and along with this if five or more images at once then the system lags.

6. **Dr. S. Ramacharan (2021)** research on A 3-Stage Method for Disease Detection of Cotton Plant Leaf using Deep Learning. In this study the CNN Algorithm is formulated on the Convolution Neural Network to identify cotton plant leaf diseases. Real time images are accumulated by means of web camera and kept in database. The input test image is acquired and pre-processed in the next stage and then converted into an array of the form for comparison. The model is appropriately trained by CNN and then organization takes place. In order to enhance disease identification rate at several stages, the training samples can be improved with the optimum features given as input condition for disease recognition.

7. **Premkumar Borugadda and Surla Govindu (2021)** studied on Classification of Cotton Leaf Diseases Using Alex Net and Machine Learning Models. According to an open-access cotton disease dataset was used for training and validating the Alex Net model. The Research framework has three phases. The first phase is pre-processing of input

image. The second phase has a feature engineering process that includes the CNN training techniques, namely Alex Net. It has two parts. The first part is featuring extraction; the second part is the classification part. The third phase had classification algorithms. Five convolution layers of the Alex Net model is used to extract the features from images and those features are feed to three fully connected layers of Alex Net and machine learning classification models for classifying the cotton leafdisease.

8. **Vani Rajasekar, K. Venu, Soumya Ranjan Jena, R.Janani Varthini and S.Ishwarya (2021)** studied on Detection of Cotton Plant Diseases using Deep Transfer Learning. The network was built using a combination of both the ResNet pertained on Image Net and Xception component. ResNet architecture was created using Tensor flow and Keros API. CNN based deep learning has performed well in labelling the majority of technical issues connect with cotton dis-eases. The Xception outperforms Inception V3 substantially on a bigger object recognition dataset with 350 million images and 17,000 classes. Deep convolution neural network for the detection of plant leaf disease. Training accuracy of 0.95 and validation accuracy of 0.98 is obtained whereas training loss of 0.33 and validation loss of 0.5was obtained using ResnNet-50.

9. **J.Karthika, K.Mathan kumar, M.Santhose, T.Sharan, Sri.hariharan. S (2021)** studied Disease Detection in Cotton Leaf Spot using Image Processing. MATLAB code is employed to size the image into greyscale to proceed into segmentation. Classification of diseases is bacterial blight, cercospora leaf spot is identified by Multi-class SVM. The dataset consists of cotton leaf images with infected leaves and normal leaves are given to the classifier for testing random image from the data set is given. K-means clustering will be applied to feature extraction and support vector machine is used to find the diseases in cotton leaves. It cannot detect if other plant leaf input is given.

10. **Akanksha Kale, Pratiksha Gade, Sheetal Gadge, Sukanya Rajbhoj and Prof. B. B. Vikhe (2021)** study Cotton Leaf Disease Detection using Image Processing. Here, Image Processing techniques along with segmentation and classified techniques are used for identification of cotton leaf disease such as bacterial blight and magnesium deficiency done using SVM. KNN is used to classify with correct disease for train the infecting cotton leaf images. The system consists of a web-based application, which will enable the farmers to take images of plants and send it to a central server where the central system in the server will analyze and pre- processing the pictures based on visual symptoms using IP algorithms in order to measure the disease type. This system is not highly efficient as it can detect only two types of diseases.

11. **Rafael Faria Caldeira, Wesley Esdras Santiago and Barbara Teruel (2021)** work on Identification of Cotton Leaf Lesions using Deep Learning Techniques. The proposed model uses GoogleNet and Resnet-50 using Convolutional Neural Networks, a precision of 86.6% and 89.2%, respectively, was obtained. The use of deep learning for the identification of lesions of cotton leaves, showing that it can indeed help in the diagnosis of agricultural pests and diseases using two models of deep convolutional networks. However, the proposed algorithm will be implemented with the use of a software which can be utilized during actual field visits to facilitate the creation of maps of the level of infestation by pests and diseases.

12. **Varun Suryawanshi and Yash Bhamare, Rahul Badgujar, Komal Chaudhary and Mr. Bhushan Nandwalkar (2020)** study Disease Detection of Cotton Leaf. Initially we take the images from the real time dataset and give it to the model for identifying the cotton disease. Data augmentation using MATLAB, one time process gives 10 rotated versions of original image. For image identification TensorFlow, Alex Net class to classify the width, height and depth of the image. CNN uses the layer for image processing, Feature detection detect significant feature of image in order to provide detection. To reduce the bigger images into smaller images strides are used. However, as the major drawback can be difficulty in collecting real-time dataset.

13. **Shantanu Kumbhar, Amita Nilawa and Shruti Pati (2019)** work on Cotton Leaf Disease Detection using CNN. The proposed system classifies leaf images by using CNN image classification algorithm. It can automatically detect and identify diseases based on features extracted by each convolutional layer. The system uses image processing techniques for disease detection. Users need to upload images of cotton plant leaves. The system can pre-process uploaded images. Images of infected plants are captured by a digital camera and processed using image growth and segmentation techniques to locate infected parts of the plant. Using CNN technology, the system can test images using a trained dataset and extract features. However, the system can be extended to any other culture as long as that culture has a large enough data set.

IV. EXISTING SYSTEM

The existing system contain various methods and models such as Visual Inspection, laboratory analysis, Spectral Analysis, Imaging, Machine learning including CNN models, DNA-Based techniques which involves drawbacks and disadvantages in many aspects. There are several potential drawbacks to using deep learning networks for cotton plant disease detection such as lack of interpretability can be a problem in fields such as agriculture, where it is essential to understand the factors that contribute to a disease outbreak. Computational complexity in Deep learning networks can be a barrier to entry for smaller farms or organizations that lack the resources to run these networks along with generalization issues and dependency on environmental factors.

Moreover, in the existing ResNet-50 system, the learning accuracy is 0.95 and the validation accuracy is 0.98, while the learning loss is 0.33 and the validation loss is 0.5. Most of the proposed frameworks in the literature study have good detection performance on their own datasets, but poor performance on other datasets, i.e., the models are less robust.

Therefore, more accurate models are needed to fit diverse disease datasets. The recent study focuses on visualization techniques than DL methods as Color mapping, Histogram equalization, Texture analysis, Edge detection, Heat mapping, 3D reconstruction make it easier to understand. Visualization techniques can be less computationally expensive than deep learning algorithms, making them more accessible to farmers and researchers with limited resources.

IV. PROPOSED SYSTEM

In our proposed system we consider CNN, ResNet models with image processing techniques that can provide an accurate and efficient method for cotton plant disease detection. The models can learn to recognize the unique visual features and patterns associated with different types of cotton plant diseases from large datasets of labelled images.

The system is categorized into two major divisions:

1. The training system
2. Image processing methods

In recent years, CNN models have been increasingly applied to agricultural applications, including the detection and classification of plant diseases. CNN models have shown great promise in detecting cotton plant diseases with high accuracy.

The following steps are followed as training model takes the input:

1. Convolutional Layers: The first few layers in a CNN model are convolutional layers, which apply a set of filters to the input image. Each filter is designed to detect specific features, such as edges, lines, or curves. The filters slide across the image and generate a set of feature maps that capture presence of these features at different spatial locations in the image.

2. Pooling Layers: The feature maps generated by the convolutional layers are then passed through pooling layers, which reduce the spatial dimensions of the feature maps by performing operations such as max-pooling or average pooling. This helps to reduce the amount of data that needs to be processed andimproves the model's efficiency.

3. Fully Connected Layers: The feature maps generated by the pooling layers are then flattened into a vector and passed through a series of fully connected layers, which perform classification based on the extracted features. The fully connected layers are responsible for learning high-level features, such as textures, shapes, and patterns, that are specific to the cotton plant diseases.

4. Output: The final layer in the CNN model is theoutput layer, which produces a prediction of the disease status of the input leaf image basedon the learned features.

The next step to proceed after training the model is Image processing technique as follows:

1. Image Acquisition: Collect digital images of cotton plants using a camera or other imaging device. Ensure that the images are of high quality and have sufficient resolution to capture the details of the plants and any disease symptoms.

2. Image Enhancement: Apply image enhancement techniques to improve the quality of the images and highlight the relevant features. This may involve adjusting the contrast and brightness, sharpening the edges, or filtering out noise.

3. Image Segmentation: Segment the image into regions of interest (ROIs) corresponding to the individual plants or plant parts. This may involve techniques such as thresholding, edge detection,or clustering.

4. Feature Extraction: Extract features from the ROIs that are relevant to the detection of cotton plant diseases. This may include texture features, colorfeatures, or shape features.

5. Feature Selection: Select the most informative and discriminative features for use in the disease detection model. This may involve using statistical techniques such as principal component analysis (PCA) or feature ranking methods.

6. Classification: Use a classification algorithm, such as a CNN or ResNet model, to classify the ROIs as healthy or diseased based on the extracted features. The model can be trained on a labeled dataset of images to learn to recognize the visual patterns associated with different types of cottonplant diseases.

7. Post-processing: Analyze the results of the classification and post-process the output to remove false positives and refine the disease diagnosis. This may involve applying filtering, smoothing, or morphological operations to the segmented regions.

Algorithm Steps for ResNet-50 Implementation

1. Obtaining the required libraries: Perhaps the important step is to import the required library for categorizing the images.

2. Download and unzip the following files: The next step is to open Google Collab and downloading the dataset file. Then it will be placed to your Collab file repositories, where we may then construct a gateway to the image or dataset we need to use. The next step is to unzip the document using the given instruction and the file's entire name.

3. Pre-processing photos for ResNet-50: Before beginning the pre-processing procedure, load a photo from the dataset. Try to change the correct target size while loading the image, which is 224*224 for ResNet.

4. Make the following estimate in Keras using ResNet-50 model: We can begin categorizing the picture after pre-processing it by simply incorporating the ResNet-50 model.

The purpose of the proposed system is to create the model that recognizes cotton crop diseases and detects the diseases. Initially, user has to upload a cotton leaf image. Image Processing begins as soon as the leaf imageis provided with a digitized color image. Data Generator reads the picture and resizes the images to target size. At last disease can be anticipated using CNN.

The output is independent of size, orientation, and light intensity. The detection accuracy of high-resolution images will also be high. Find the overall accuracy of the system. Finally, the output is obtained after the detectionof the disease. The output is an image of the leaf with the name of the detected disease.

However, the difficult aspect of building an object detection model is collecting a large number of training images of different shapes, sizes, backgrounds, light intensities, orientations, and aspect ratios.

Further research could be conducted to detect all forms of plant disease and suggest treatments for the disease. The system can also be combined with IoT servers to create a system that can be used in rural and remote areas.

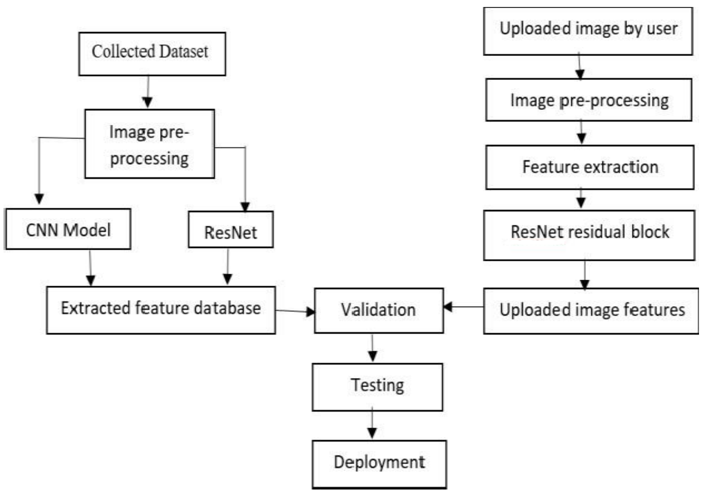

Fig -1: System workflow

V. CONCLUSIONS

The uploaded input images from the user are processed by the system and produced output with detected disease. The use of image processing techniques, CNN, and ResNet models for cotton plant disease detection has potential to improve the efficiency and accuracy of disease diagnosis in cotton crop.

By automating the detection process and providing reliable and accurate results, this technology can help farmers and researchers to quickly identify and respond to diseases, preventing further spread and reducing crop losses.

In India, where cotton is an important cash crop, the impact of plant diseases can be significant, leading to reduced yields, lower quality cotton, and eco- nomic losses for farmers. The use of advanced technologies such as image processing, CNN, and ResNet models for disease detection can help to mitigate these risks and improve the overall productivity and profitability of cotton farming in India.

Moreover, the adoption of these technologies can have a positive impact on the livelihoods of small- holder farmers, who often lack the resources and expertise to diagnose and treat plant diseases effectively. By providing a simple, user-friendly, and cost-effective solution for disease detection, this technology can help to level the playing field and enable smallholder farmers to compete with larger, more resource-rich operations.

Overall, the use of image processing, CNN, and ResNet models for cotton plant disease detection has greater and better potential to transform the process of methods cotton is grown and managed in India, improving yields, reducing losses, and supporting the livelihoods of millions of farmers across the country.

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