Diseases Detection in Cotton Faring Using Deep Learning

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Abstract. The primary crop in the world is the cotton, it is widely grown. India's very important profit crops and fibers, the nation's agricultural and industrial depend on cotton. It provides The Cotton fiber, a basic raw ingredient, to the cotton textile industry. In India, six million farmers rely on the cotton field for their living, while between 50–60 million people work in cotton trade and processing. Several plant related illnesses, the yield and productivity are greatly reduced as a result Finding the illness at an early stage is big challenging. The deep leaning method was applied to provide a classification suggestion for cotton plant. Sequential CNN model was used to focus on most real-object identification system for classifying and detecting corrupted images and diseased and it give 90% accuracy.

Keywords: MLP, Random forest , Sequential CNN and Cotton Disease detection,

1 Introduction

In India, a country that is predominantly rural and where 48.9% of the population works in agriculture, farmer suicides are one of the most difficult problems to solve. According to NCRBOI(National Crime Records Bureau of India) reports that between 1995 to 2014, Total the farmer committed suicides in India around 296438 . Farmer suicides continue to be a big problem in India today despite several efforts by the Indian government to increase farmers' incomes and give them more authority. Farmers who committed suicide due to "bankruptcy or indebtedness," "family problems," "crop failure," or "illness," the four factors that contribute most frequently to suicide among farmers. the current approach for detecting cotton plant diseases is that they can be spotted with the naked eye and knowledge of cotton plant diseases. It is time consuming, difficult, and inaccurate to do so on a large number of cotton plants.

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Expert consultation is expensive. In such circumstances, suggested procedures are used where gadgets are employed for the automatic detection of diseases, making the process cheaper and easier. A high level of intricacy is added by visually examining symptoms on cotton plant leaves, where the plant disease may be clearly recognized, adds a high level of intricacy. Agriculture has play most important role for developing country economic. Cotton has the second important crop for country development, manufacturing [1].The most widely used fibre for making garments and other textiles is cotton. Around the world, cotton produced 25 Million tonnes per year. [2]. China, the world's top cotton grower, collected more than 6.4 million tonnes of cotton in 2021, or about 480 pounds each bale. the country, India is the origin of cotton, which is very important to the national growth of the economy. In india has more land place available for cotton cultivation than China, in spite of China having the second-highest production cotton over the last two years,. India has likely to use all cultivable land, it goes top of the list [3]traditional machine learning and computer vision classifiers are frequently used in disease detection in plant [4]. The main focus on this model is to diagnose a cotton Plant Disease offer a cure. Here, based on a spot on the leaves, the sequential CNN and Resnet model is utilised to predict if the plant is infected or not. The offered research projects use the idea of ensemble learning, which is carried out via a deep learning algorithm. Following implementation, the final results are contrasted to determine which version has the highest accuracy [5]. The sequential model focus on accurate for a simple layer of stack, exactly one input sensor and out sensor are present for each layer . Once a Sequential model is constructed, it operates similarly to a Functional API model, wherein each layer possesses both input and output attributes. These attributes can be effectively utilized to accomplish various tasks, such as rapidly generate a model that captures the outputs of all intermediary layers within a Sequential model.There are two types of APIs in Keras: Sequential and Functional. Today, we'll use the Sequential API to build a CNN. In the Sequential API, we add layers to the model one by one (hence the name Sequential). It is easy to work with the sequential API. In contrast, the Sequential API has limited flexibility when it comes to incorporating branching layers, and it does not support the inclusion of multiple inputs and outputs within the network

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2 Literature Review

Detection of cotton leaf disease and pest detection used CNN model, Future IOT device capturing images in the field[5]. The YOLOv3 algorithm was used the utilized model has an MAP(Mean, Accuracy and Predication), The future prospects of deep learning in the system involved the integration of YOLOv3, a popular object detection algorithm, with neural network techniques. This combination enhanced the system's capabilities by leveraging the strengths of both approaches, leading to improved accuracy and efficiency in object detection tasks [6] .Deep learning model for CNN ,inception V3 and resnet Apply explainable AI and giving behind the classification

and potion responsible for classification[7]. The CNN method was employed in controlling the spread of fungal diseases in cotton plants, aiming to mitigate the loss of cotton yield. To enhance prediction and accuracy, combination two are more models can be implemented for the classification and detection of cotton plant diseases. By integrating various models, the system can achieve improved performance in identifying and categorizing diseases affecting cotton plants. [8].Improved Cotton plant disease recognition Using Deep Convolution neural network(DCNN) ,Resnet50 , vgg 19 And inception Identify the disease Accuracy 75.5 ,85.5 and 96.64%, These model can be apply for different plant for disease detection[9]. Faster and pre trained model like VGG16 and Resnet, suggested observation model on various types of Diseases [10], The cotton leaf are infected by the different types Disease likely Bacterial blight, targetspot, cercospora and ascochyta applied by CNN Model (average accuracy 96%), Enhanced many more images and work with many other categorical of disease which will to farmers to identify the disease in cotton[11] Recognition of different plant diseases is the key to advert the losses in the yield production and gives amount of product in agriculture. It needs a huge quantity of effort, fact of plant diseases, and immoderate processing time. Consequently, plant disease detection uses image processing steps like image acquisition, image pre-processing, image enhancement, image restoration, segmentation and feature exaction and classification. [12] We mix with "Deep Feature extractors" like Residual Network (ResNet) and VGG with each of these meta-architectures. It shows how meta-architectures, process the feature extractors and classification perform and provides a technique for global and local class annotation. The data augmentation to improve precision or accuracy and number of false positive decreases during training. The big pests cotton Diseases dataset, which includes difficult images with pests and diseases various inter and extra class variables, such as diseases state and position in the plant, is used to Train and test our systems from start to finish [13] India got top rank in the world in the cotton acreage 125.67 lakh of hect under cotton crop cultivation during 2022-23.Around 70% of india cotton grown on irrigate area 40% and rain fed area 30%.production,are and yield of cotton for last six year is at rank with yield 505(lint in kg/ha)[15].

Acreage under cotton and yield		
Year	Acreage (in lakh hectares)	Yield(Lint in kg/ha)
2017-18	126.5	500
2018-19	127	449
2019-20	134.76	460
2020-21	130.77	462
2021-22	120.69	510
2022-23	125.67	505

Table 1:Area of land under cotton and yield Acreage under cotton and yield production acreage (in lakh hectares) during period from 2017- 18 to 2022-23.

Year	production(in lakh bales)	consumption(in lakh bales)
2016-17	345	310.45
2017-18	370	320
2018-19	333	311.22
2019-20	365	269.19
2020-21	353.84	334.87
2021-22	362.18	338
2022-23	341.91	315

Table2: The details of india production and consumption of cotton during at last 6 year given above.In India production and consumption of cotton during from 2016-17 to 2022-23.india got first place for production in the year of 2017-18 and consumption in the year of 2021-22.

3 Methodology

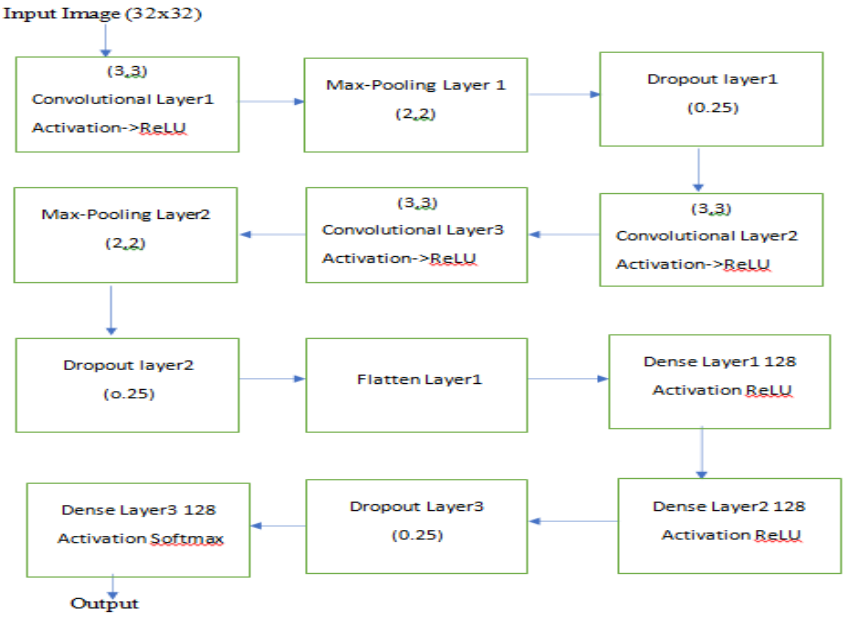

Fig 1:Proposed Sequential CNN Model

The utilize CNN model Due to success in feature extraction and thus the image identi-

fication problem

Data Set description

The cotton leaf images for this work were collected from kaggle and field work around 2000 image like alternaria, bacterial blight, cercospora, grey mildew and healthy. So the dataset contain 5 different types of leaves with different disease and healthy leaves.

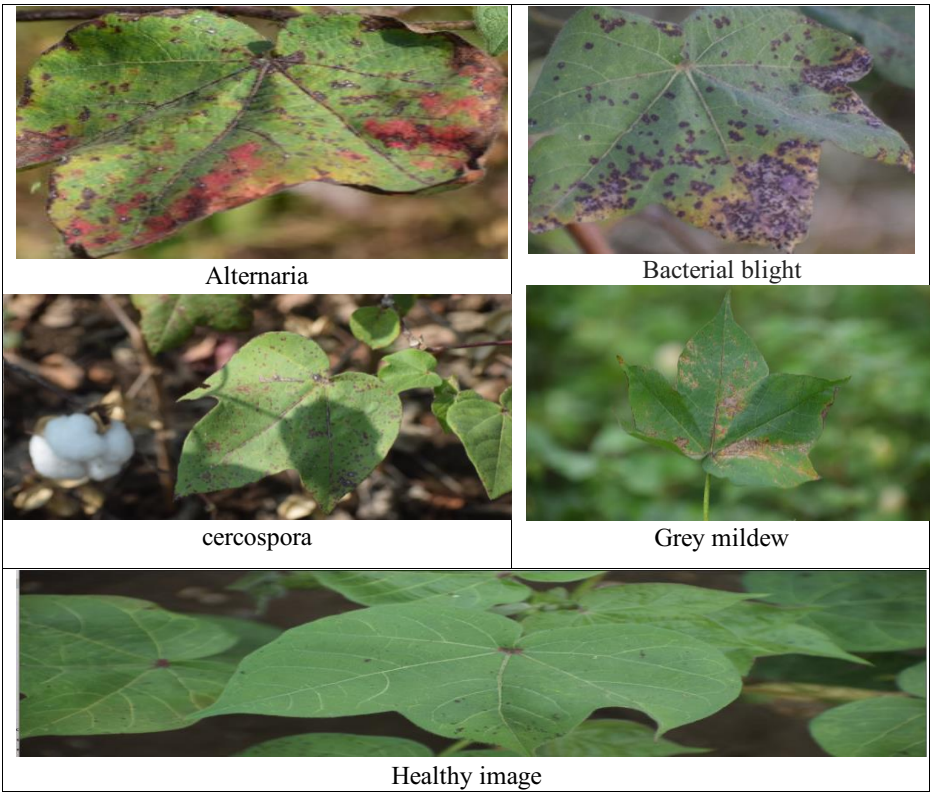

Fig 2: visualization of cotton diseases images and healthy images

Sequential CNN Algorithm

the various convolution neural network layers perform matrix operations on input image matrix.The following layer are:

Step1: Convolutional layer: in this layer filter uses filter or kernal(K) to perform operation on a 32x32-pixel image as an input matrix to create a feature map. The kernels, or updated weights, in neural networks are learnt as the network is taught. ReLu activation is used to ultimately normalise the data. Consider about the following: "b" is the bias, and Kernel (K) is the weight,"i,j" and "$k_1 k_2$ "are theindices for the many elements of the filter matrices and images respectively. The output of

matrix operation

"X": $X_{i,j}$ =∑∑I_i+k_1,j+k_2k*$K_{k1,k2}$ +b_{k12}……… (1)

y_i=f($X_{i,j}$)…………………………………….. (2)

f(X) = max(0, X) …….Activation function (ReLu)…..........(3)

Step 2:Pooling layer: The result from the preceding layers are integrate in this layer. To take the largest possible value of the window size, use Max Pooling. It Contain Feature maps.

For Feature map having Dimensions m_a*m_b*m_c

(m_a-d+1)/n *(m_b-d+1)/n *m_c

Where
n - Stride Length
d- Size of filter
m_a - Height of Feature Map
m_b- Width of Feature map
m_c - Number of channels in the Feature Map

Step3 Flatten Layer: The use of this layer is convert to The features from a three-dimensional representation into a one-dimensional input suitable for the neural network. This is accomplished by flattening the features. The mathematical representation of the flatten layer can be written as follows: Let's say the output of the previous convolutional or pooling layer has dimensions (m_1×m_2 × m_3) where m, m_2, and m_3 are the number of feature maps, height, and width, respectively. Then the flatten layer reshapes this output into a 1D vector of size (m_1×m_2 × m_3) which can be denoted by a column vector X of length (m_1×m_2 × m_3) .So the mathematical representation of the flatten layer can be written as

X = [$y_{1,}y_{2,}$……..y(m_1×m_2 × m_3)]^T

where $y_{1,}y_{2,}$……..y(m×m_2 × m_3) are the activations of the previous layer arranged in a 1D vector, and the superscript T denotes the transpose operation to obtain a column vector. This flattened vector x can then be fed into one or more fully connected layers for further processing and classification.

Step4:fully connected neural network: this layer has nodes which is uniform number of classes and it's then forecast the class labels

Step5:SoftMax : The result of neural networks is transformed into class, probabilities for every label by the SoftMax activation function.

4 Results and Discussions

Training the Model**:**Train model with 20 epoch, test case 1, run on a single image Twenty times, the training result of the first stage is 0.4295 and the valid accuracy of the first stage is 0.4941, specify that model is not that good. However, when we process up to the 10th epoch, the training accuracy was 0.90.2, shown in fig 3

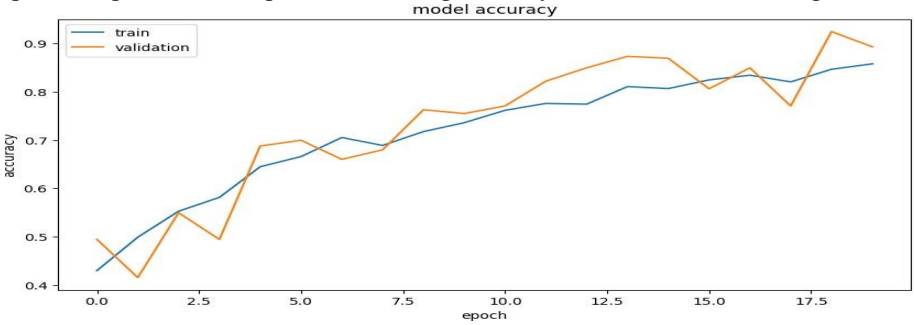

Fig 3: Sequential CNN model training and validation process

The graph portrays the accuracy achieved in detecting diseases within cotton plants through the utilization of the Sequential CNN model. The graph includes both training and validation accuracy data. Notably, the sequential model demonstrates exceptional performance, yielding a high accuracy rate of 90% in this context.

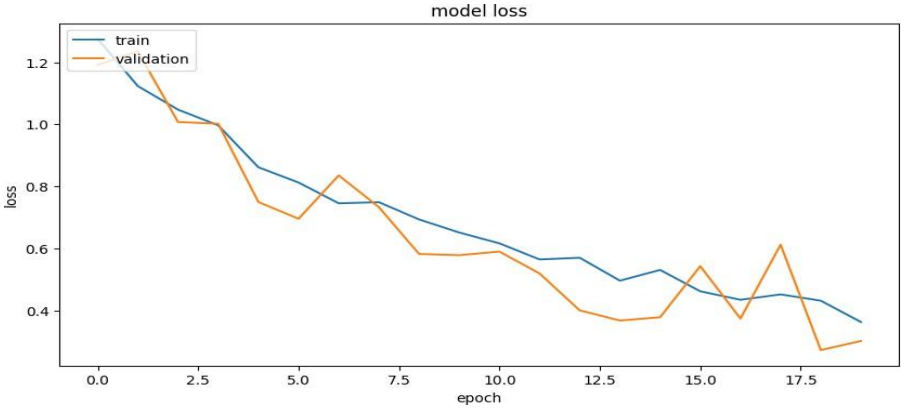

Fig: 4 Sequential Convolutional neural network model (SCNN) loss graph

The figure 4 depicts the loss observed in the task of disease detection in cotton plants through the application of the Sequential CNN model. The graph provides insights into both training and validation loss. Notably, it showcases the variance in loss during the process of training and validation.

Table 3: Metrics of different Algorithms

Algorithm name	Accuracy	Precision	Recall	F-score
sequential CNN	90.2	90.34	90.49	90.1
RESNET54	85	83	84.5	84
MLP	75	75.15	75.1	74.1
Random Forest	74	74.1	72.31	72.12
Decision Tree	73	70.4	70.73	70.2

The sequential CNN , Resnet-54,MLP,Random forest and decision tree, its accuracy,precision,recall and F-score .the Sequential CNN model gave high accuracy in the all aspect among other models.To Forecast the value of the objective feature using the values fetched from the user through interaction. We will be using various types of algorithms in order to predict the value of the objective feature. Algorithms like sequential CNN,Resnet54, MLP, Random Forest, Decision Tree,etc. can be used to predict the value. We will then compare all the used algorithms and select the one that gives better results. By results we got sequential CNN gives Better Accuracy than all other Algorithms.

5 Conclusion

Cotton plant easily infected with disease, mainly leaves, There are five different types model, including, sequential CNNResnet54, MLP,Randomforest and decision tree have compared. Sequential provide test accuracy 90.2%, ResNet provide accuracy 85%,MLP provide accuracy 75% ,random forest provide accuracy 74% and decision tree provide accuracy 73% respectively as per experiment. The sequential CNN model is a great choice for commercial applications because it has a lot fewer parameters than other models, which will speed up the process of forecasting sickness. In the future, the approach will be put into real life with the use of computer software, allowing a human to visit a farm and promptly and protection to take preventative actions after discovering sick plants or cotton leaves.

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