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Cotton Crop Disease Detection Using Inception v3 Model

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Abstract: -

Agriculture is one of the major sectors in our society and from the medieval times, it's the sector that we've dwelled upon. About 60-70 of Indian population depends on the agrarian assiduity. Conditions in shops beget major product and profitable losses also as reduction in both quality and volume of agrarian products. Currently factory conditions discovery has entered adding attention in covering large fields of crops. Early information on crop health and complaint discovery can grease the control of conditions through proper operation strategies. Leaf conditions on cotton shops must be linked beforehand and directly because it can prove mischievous to the yield. The proposed work presents a pattern recognition system for identification and bracket of cotton splint conditions. This fashion will ameliorate productivity of crops. The model that we've created is trained to assay and understand whether the splint contains complaint or not. We're using the Inceptionv3 algorithm.

Key-words: - Convolutional Neural Network (CNN), Deep Learning, Inception v3.

Introduction: -

Plant diseases are one of the major reasons behind the production and economic losses in agriculture. Identifying disease correctly may be a challenging task and requires expertise.

There are various diseases which obstruct the growth of cotton crops in fields which may cause huge loss in the quality of products. Nowadays image processing is used a lot for detecting such diseases. Microbes like the germ, fungus, and bacteria are the main cause of the disease to cotton crops due to failure in excellence and extent of production. It is a huge loss to the farmer and economy as cotton is an important commodity in the world economy[1].

The neural networks are an emerging application in numerous and diverse
areas as examples of end-to-end learning. This paper is based on a system which implements Convolutional Neural Network to detect cotton leaf diseases.

We are using the Inceptionv3 neural network model which uses transfer learning to detect disease in a plant. A large number of model accuracy tests are carried out by training neural networks with different parameters. When the network parameter Batch is set to 32. The training precision and test precision of the network reaches the utmost. Its training precision rate for crop disease image recognition in the Test Dataset is 89%, and the precision rate on the test set is as high as 84%, far exceeding the accuracy of manual recognition. This fully proves that the deep learning model supported Inception-v3 neural network can effectively distinguish crop disease.

Methodology:

Proposed system

1. Dataset Classification
2. Building the CNN using transfer learning
3. Training our Network
4. Testing

1. Dataset Classification:

● Image pre-processing

In these phases, we require better resolution images and with better quality. of these images are resized with specific manner and determination. These images we remove noise content and rotate the pictures employing a data augmentation process.

● Feature extraction

In this feature extraction process, extract a number of the important features of the defected leaf. It can create colored structure and convert the RGB color to gray scale or the other way around of defected parts of cotton leaf image. The feature we will use to coach our neural network[2].

```
def to_grayscale_then_rgb(image):
    image = tf.image.rgb_to_grayscale(image)
    image = tf.image.grayscale_to_rgb(image)
    return image
```

```
[ ]  # Use the Image Data Generator to import the images from the dataset
     from tensorflow.keras.preprocessing.image import ImageDataGenerator

     train_datagen = ImageDataGenerator(rescale = 1./255,
                                        shear_range = 0.2,
                                        zoom_range = 0.2,
                                        horizontal_flip = True,
                                        preprocessing_function=to_grayscale_then_rgb)

     test_datagen = ImageDataGenerator(rescale = 1./255)
```

Figure 1: Code of Feature Extraction from the leaf image

1. Building the CNN using transfer learning

Image identification has become feasible with the advent of Convolutional Neural Networks. But designing a CNN that identifies objects and classifies them into distinct classes is a complex task. By making use of transfer learning, it can be simplified. In transfer learning we have trained our model that has been trained on Cotton Image dataset[6] using TESLA T4 GPU.

```
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 460.67       Driver Version: 460.32.03    CUDA Version: 11.2     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|                               |                      |               MIG M. |
|===============================+======================+======================|
|   0  Tesla T4            Off  | 00000000:00:04.0 Off |                    0 |
| N/A   40C    P8     9W /  70W |      0MiB / 15109MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                                  |
|  GPU   GI   CI        PID   Type   Process name                  GPU Memory |
|        ID   ID                                                   Usage      |
|=============================================================================|
|  No running processes found                                                 |
+-----------------------------------------------------------------------------+
```

Figure 2: System Configuration

Also Transfer learning significantly reduces training time and gives much better performance for relatively small dataset [5]. Google has released pertained models on tensor flow ‘s official website. “Inception v3” is one of such models that is trained on ImageNet dataset and can identify 1000 classes

such as television, keyboard, car and some animals. It is one of the most widely used model for image classification. The Inception v3 network is 48 layers deep and has an input image size of 224 by 224 [3].

```
[ ]  # Make sure you provide the same target size as initialied for the image size
     training_set = train_datagen.flow_from_directory('Datasets/train',
                                                      target_size = (224, 224),
                                                      batch_size = 32,
                                                      class_mode = 'categorical')
```

```
[ ]  test_set = test_datagen.flow_from_directory('Datasets/test',
                                                 target_size = (224, 224),
                                                 batch_size = 32,
                                                 class_mode = 'categorical')
```

Figure 3: Code representing (target size, batch size and class mode) of training and testing dataset

The network takes image as input and gives label as output. The characteristic of Inception v3 is factorization. The purpose of factoring convolutions is to decrease the parameters and connections while retaining the efficiency of the network [4].

2. Training our network

The deep convolutional model can be used to classify labels specific to the task at hand. For this the Inception v3 model is loaded. New classes to be recognized are specified and the Inception v3 model is trained over different batches for a certain number of epochs, thus harnessing the image classifying abilities of Inception v3 to classify diseased plants.

```
# fit the model
# Run the cell. It will take some time to execute
r = model.fit_generator(
  training_set,
  validation_data=test_set,
  epochs=20,
  steps_per_epoch=len(training_set),
  validation_steps=len(test_set)
)
```

Figure 4: Code for Number of epochs used

The Inception v3 model is iteratively trained over different batches for a certain number of epochs. Labels for each of the diseases are provided to the network along with the images belonging to the label.

3. Testing

The trained model is tested on a set of images. Random images are introduced to the network and the output label is compared to the original known label of the image. Parameters used for evaluation are F1 score, precision and recall. Precision is the proportion of predicted positives that are truly positives.

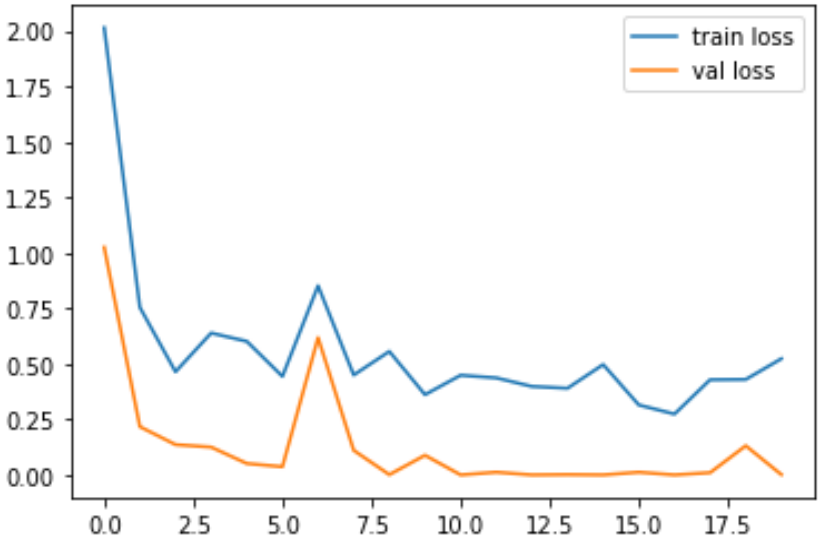

Figure 5: Loss Plot

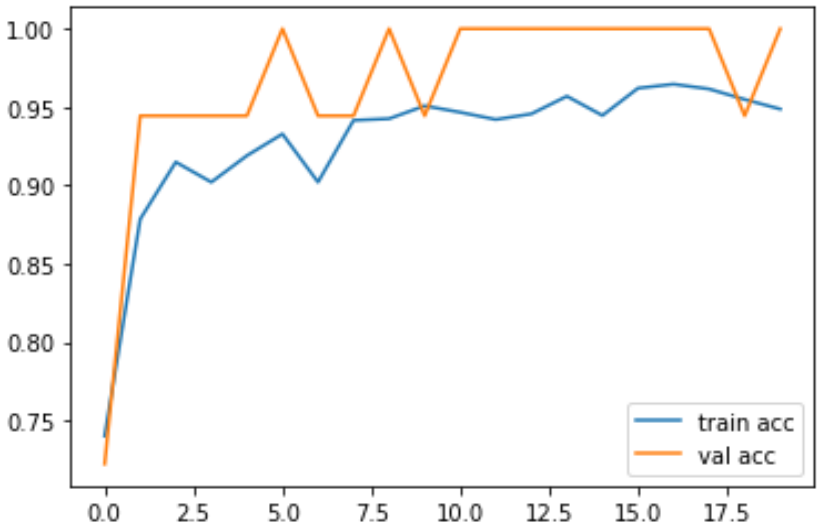

Figure 6: Accuracy Plot

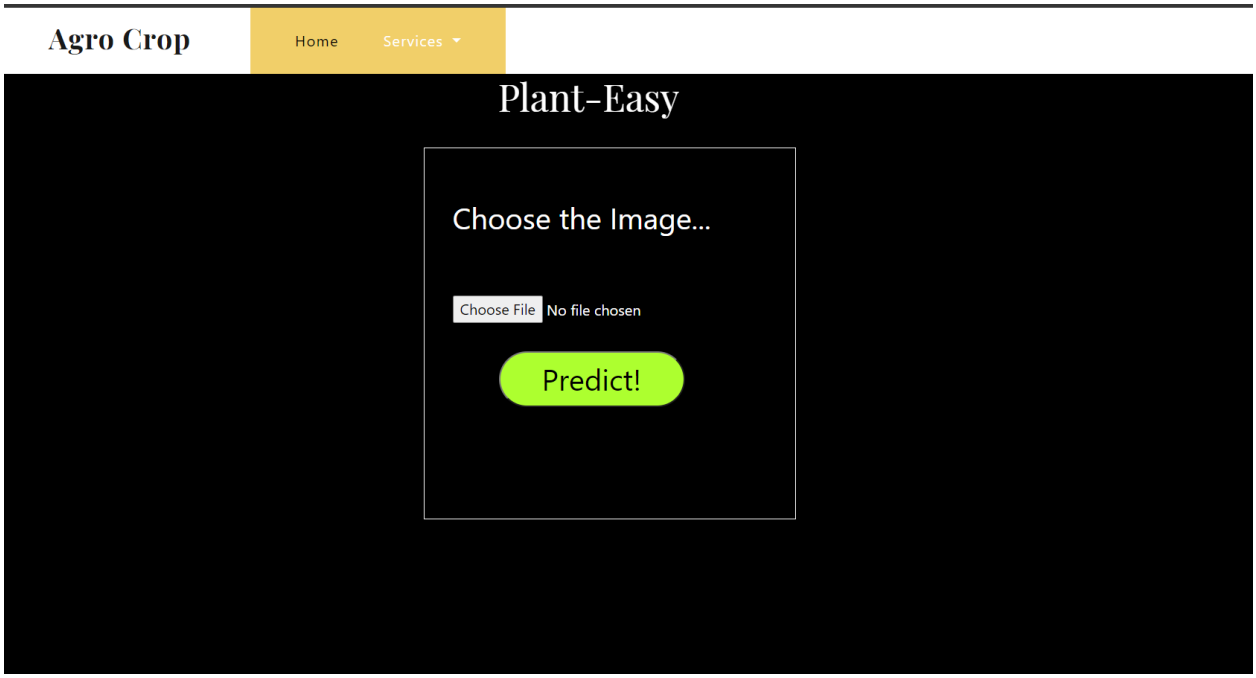

Figure 7: Interface of the Web application

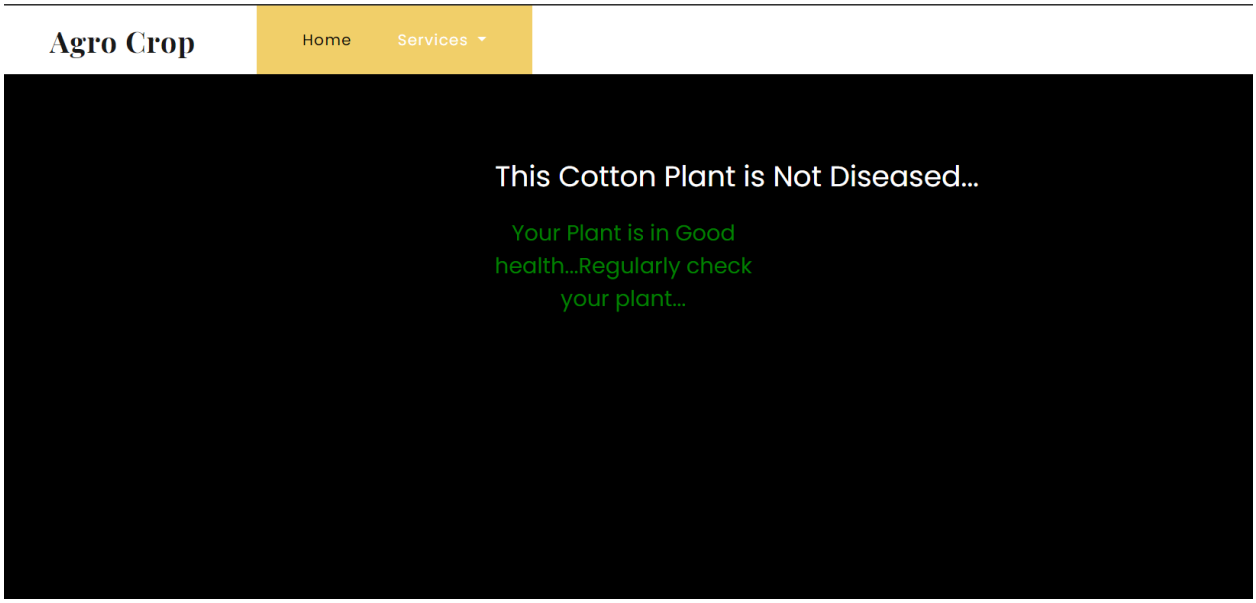

Figure 8: Result of a healthy leaf

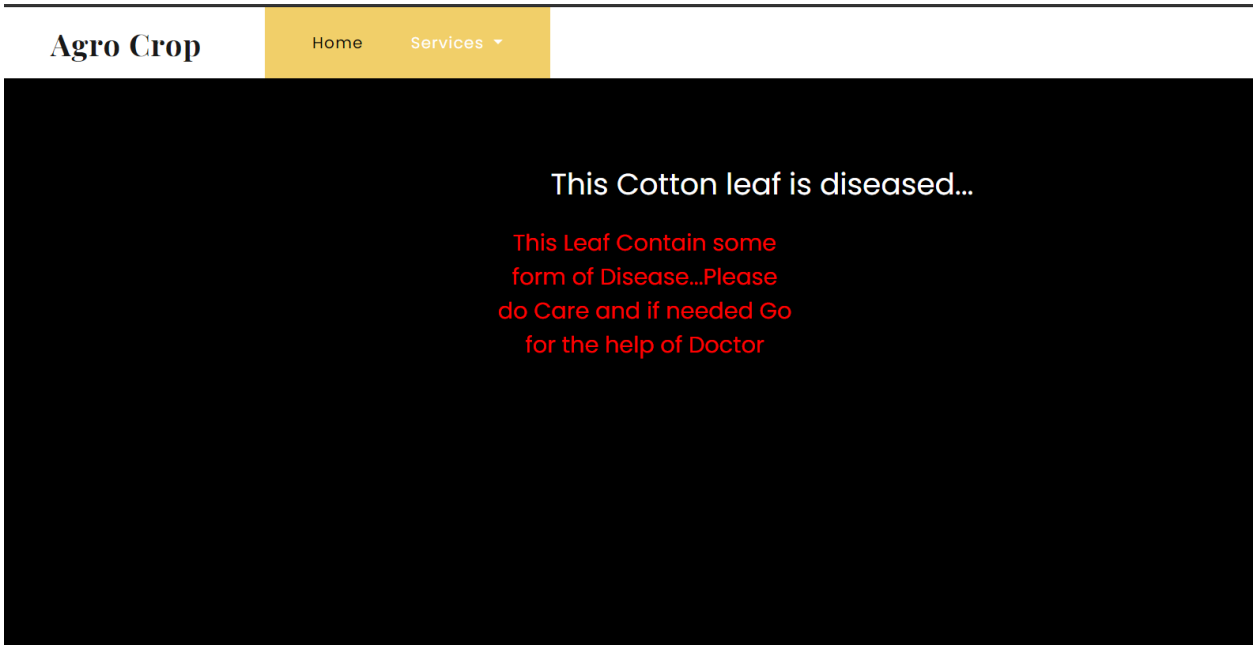

Figure 9: Result of a diseased leaf

Project Description

Block diagram

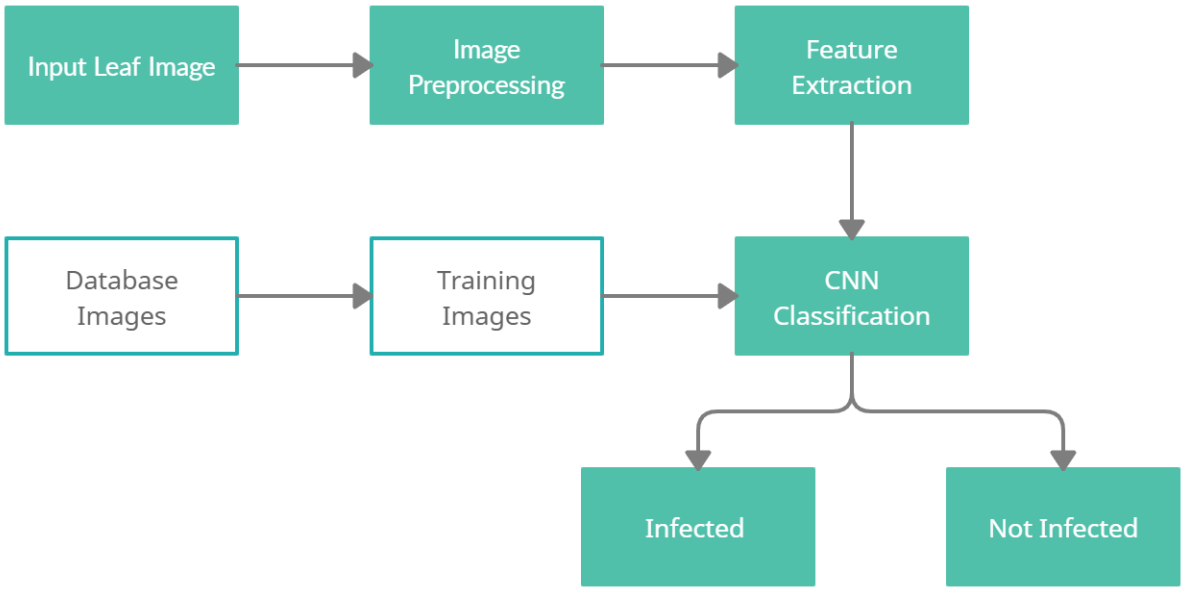

Figure 10: Block diagram

Tools Used:

- Google-Colab supports both GPU and TPU instances, which makes it a perfect tool to train the model on large datasets
- We have also used various data science related libraries like Keras, Tensorflow, Sklearn, OpenCV, Matplotlib, Numpy etc. For the purpose of building the Keras model we have used sequential modelling technique.
- VS Code is used for overall development as a standard platform.
- Flask is used to design GUI of the Web Application.

Activity diagram

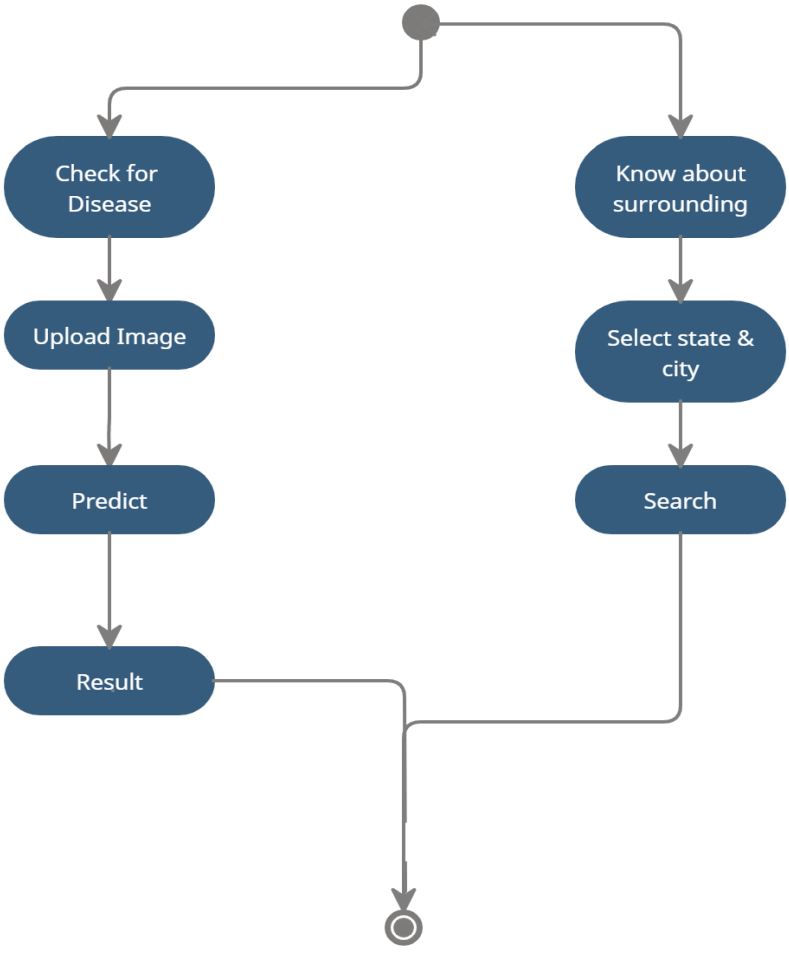

Figure 11: Activity Diagram

Conclusion:-

This paper proposes a CNN based method for cotton plant disease classification using the leaves of diseased plants. Building such a neural network with high efficiency is a complex task. Transfer learning can be employed to achieve greater efficiency. Inception v3 is one of the models available that inherently have the capability to classify images and further can be trained to identify different classes. Thus, use of Inception v3 can play a key role in obtaining fast and effective plant disease identifiers. Also by dataset classification, the training set can be chosen to ensure proper training of model for all features. This provides better feature extraction than randomly classifying the dataset. Optimal results were obtained by employing the methods specified in the paper. Thus, with implementation and use of these methods for plant disease classification losses in agriculture can be reduced.

References:-

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