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Biomedical Image Analysis of Tomato Leaf Disease

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Abstract: -

India is an agricultural country and its economy is highly dependent on agriculture. Over 70% of the rural homes are dependent on agriculture. So, it's a huge responsibility of farmers to take care of crops. They have to check their crops on regular basis whether they are healthy or affected. There are thingsthat lead to different disease for the plant leaves, which spoiled crops and finally it will affect economy of the country. These big losses can be avoided by early identification of plant diseases. Manual leaf disease detection takes much time and labor work while automatic leaf disease detection can predict the disease within a couple of seconds. So, this paper is a technical brief on Biomedical Image Analysis (Leaf Disease Detection) and its applications, future scope and basic python modules needed for it.

Keywords: -TensorFlow, Keras, OpenCV, NumPy, Matplotlib, Flask

Introduction: -

Biomedical Image Analysis of Tomato Leaf Disease software is used to detect the leaf disease at a very early stage so that it can be prevented from damage. Farmers have variety of options to cultivate crops in the field. Still, the cultivating these crops for best harvest and top quality of production is done in a technical way. So, the yield can be increased and quality can be improved by the use of technology. So, first and the foremost thing that indicates whether a plant is healthy or not is leaf. The color and the texture of a leaf can be used to detect the disease. This software is possible with the help of python modules as python has a huge pre-defined library.

The software requires the concept of neural networks and the package that is used for this work is Keras and at the backend TensorFlow has been used. Once the dataset had been loaded in the system, the first work is to transform the images to their corresponding pixel values in an array and preprocess the images using OpenCV and detect the color and the spots present on a leaf. Hence, this part is known as training. After that some images are to sorted for testing purpose. The frontend of this project is based on HTML (Hyper Text Markup Language) and CSS (Cascading Style Sheet). The backend, i.e., Python files is connected to the frontend, i.e., HTML and CSS using another python library known as Flask. The resultant HTML file have an option to upload a jpg/jpeg format picture of a leaf to detect the disease and also print two lines for the treatment of the disease.

Basic Python Modules:

1. **TensorFlow**

   from tensorflow. compat. v1 import ConfigProto
   from tensorflow. compat. v1 import InteractiveSession
   import tensorflow as tf

2. **Keras**

   For Training Datasets:

   from tensorflow.keras.models import Sequential
   from tensorflow.keras.layers import Conv2D

from tensorflow.keras.layers import MaxPooling2D
from tensorflow.keras.layers import Flatten
from tensorflow.keras.layers import Dense
from tensorflow.keras.preprocessing.image import ImageDataGenerator

For Testing Datasets:

from tensorflow.keras.preprocessing.image import load_img
from tensorflow.keras.preprocessing.image import img_to_array
from tensorflow.keras.models import load_model

For connecting python files to HTML file:

from tensorflow.keras.preprocessing.image import load_img
from tensorflow.keras.preprocessing.image import img_to_array
from tensorflow.keras.models import load_model

3. **OpenCV**
   import cv2
4. **NumPy**
   import numpy as np
5. **Matplotlip**
   import matplotlib.pyplot as plt
6. **Flask**
   from flask import Flask, render_template, request

Basic function and operation of the project: -

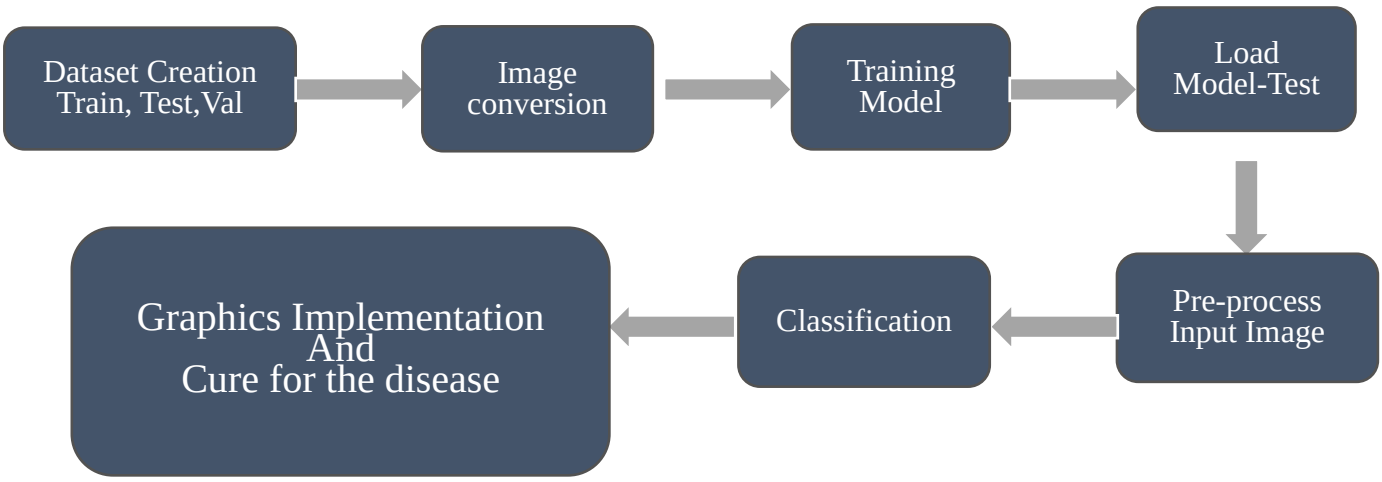

Fig 1. Basic functions and operations

Firstly, dataset had been loaded to the system and split into three folders, i.e., Training, Testing and Validation. After loading the images, convert the following into their respective pixel values in an array format. Training model consists of the part Pre-Processing which is done using OpenCV and after training, testing is done by applying the path of the desired image into the python code. The desired image is pre processed and matched with the training model and finally give the classification/prediction. This model is implemented in an HTML page to make it easily available to everyone.

	train	validation	test
Top-3 Accuracy	0.999	0.997	0.997
Top-1 Accuracy	0.999	0.974	0.971
Precision	0.999	0.976	0.974
Recall	0.999	0.973	0.970
F1	0.999	0.974	0.972

Fig 2. Accuracy chart

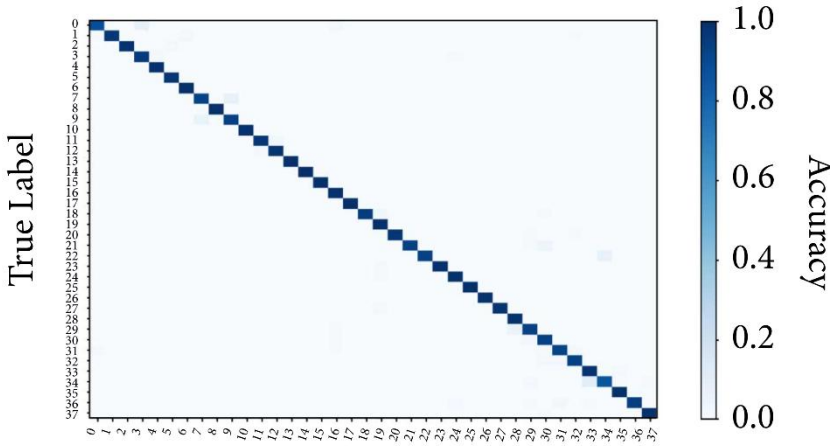

Fig 3. Confusion Matrix

Output: -

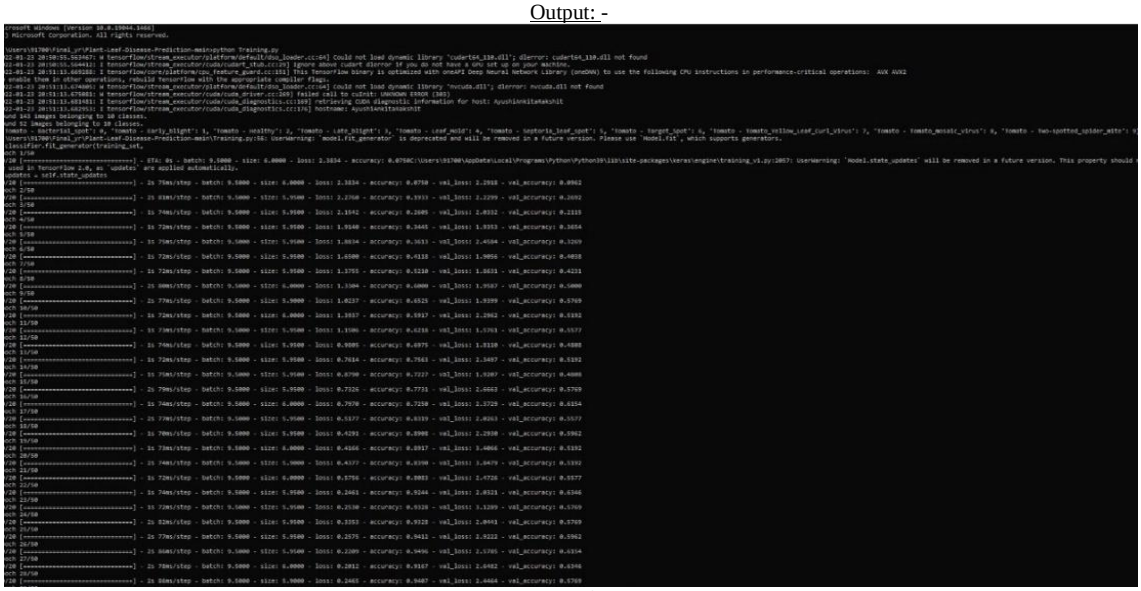

Fig 2. Output screen of Training Dataset

Fig 3. Output Screen of Testing Dataset

Future Scope and Applications: -

- Developing Rich Graphical User Interface (Front End Website Development).
- In the next stage after the Completion of the project,an application on to a server can be introduced so that it can be easily available to everyone.
- More datasets can be added into the application so that it broadens the range of data collected and hence more leaf diseases and its corresponding treatment can be done.

Conclusion: -

In this paper, main idea of Biomedical Image Analysis (Leaf Disease Detection) and modules required for this are described. Then the basic operations and functions needed for the development of this project are discussed briefly. Thus, efforts are continuously made to use the benefits of this technology as far as possible.

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