DEEP LEARNING MODEL FOR DETECTNG DISEASES N TEA LEAVES

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report **"DEEP LEARNING MODEL FOR DETECTING DISEASES IN TEA LEAVES"**is the Bonafide work of the following students, **NAGAJOTHI D(113820121007), KESAVAN A(113820106308), KARAN M(113820106309),JAYABHARATH G (113820106307)**in partial fulfillment for the award of the **NAAN MUDHALVAN** and the project work is carried out under my supervision.

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ABSTRACT

Detecting diseases in tea leaves can be achieved using deep learning models. The first step is to collect a dataset of tea leaves images with and without diseases. The dataset should have a good distribution of images with different types of diseases to ensure that the model can learn to distinguish between healthy and diseased leaves. Once the dataset is ready, you can use a convolutional neural network (CNN) to train a deep learning model.

CNNs are particularly suited for image recognition tasks, as they can learn to extract meaningful features from images. In the case of tea leaves, the model will learn to identify patterns and textures that are indicative of diseases, such as discoloration, spots, or unusual shapes. The output of the model will be a probability score indicating the likelihood of a tea leaf being diseased.

To improve the accuracy of the model, you can use techniques such as data augmentation, transfer learning, or ensembling. Data augmentation involves generating new training samples by applying transformations such as rotations, flips, or zooms to the original images. Transfer learning involves using a pre-trained model as a starting point and fine-tuning it on the tea leaves dataset. Ensembling involves combining the predictions of multiple models to produce a more robust and accurate final prediction.

Overall, deep learning models can be a powerful tool for detecting diseases in tea leaves, but they require a significant amount of data and expertise to develop and deplop.

1.INTRODUCTION

quali1.1.Project Overview:

Tea is one of the essential beverages in Bangladesh. Mostof the Bangladeshi people start their day with a cup of tea. Bangladesh has become an important tea producing Country.Today the country has 172 commercial tea estates [1].The districts that produce tea are Maulvibazar,Habiganj,Sylhet,Chittagong, Panchagarh, Brahmanbaria, and Rangamait [2]. Almost the entirety of the district of Sylhet is the standard tea garden area and Srimangal is known as the tea capital of Bangladesh [3]. Tea is the second largest export based cash crop of Bangladesh. The industry accounts for 1% of the national GDP of Bangladesh [4]. Tea production in Bangladesh is greatly hindered due to a number of pests and diseases, caused by a variety of insects, mites, nematodes,bacteria, algae, fungi, weeds, and other diseases which arecaused due to the environmental condition of that particular region [2].

Bangladesh is an agricultural country where more than 75% population rely on agriculture directly or indirectly [4]. Approximately 20% to 30% of the tea leaves are lost due to various diseases each year [5]. Farmers in the field judge the identification of tea leaf diseases with their naked eye and previous experience. Many a times, experts are needs to be called in to analyze the tea leaves when there is ambiguity in detecting the diseases by local farmers; this process is not only time consuming, but also costly. It is important to catch the spread of the disease in its early stages before they reach epidemic proportions; otherwise the disease can spread quickly throughout the entire plantation, resulting in huge losses for the farmers. To aid the farmers in the crucial task of identifying tea leaf diseases in their infancy, it is practical to have an intelligent system of detection,identification, and classification system in place as a preventative measure. The first sign that something is wrong with the leaf is usually indicated by a change in color from a healthy dark green hue. When the tea leaf is healthy the color is distinct, but when the leaf is affected by disease, the color of the leaf changes drastically. Each disease usually has a distinguishable leaf color and texture as symptoms.The latest trends of research in agriculture are toward the use of gene technology to develop disease resistant variant of the plant, and to increase f ty and productivity of the plant with reduced expenditure . Numerous technological improvements are responsible for the progress in crop management techniques in recent times; including advances in information technology, remote sensing technology, and image processing and pattern recognition [6-7].Therefore, now it is possible to develop and deploy an autonomous system for detection, identification, and classification of diseases in crops in very large fields with minimal manual input. A search through recent literature have identified research in various types of crop diseases including diseases in rice, citrus, Betel vine, and wheat leaf to name a few [8]. However, research into diseases of tea leaves is one area that has not yet seen any significant efforts. Therefore, there should be a way to developtea leaf disease recognition and detection to help the tea industry in Bangladesh. In this paper, Support Vector Machine classifier (SVM) is used to recognize the diseases of tea leafs.

1.2 .OBJECTIVE[Purpose]

The objective teave for detecting diseases in tea leaves is to identify and manage any plant diseases that could potentially reduce tea production and quality. Disease detection is critical for tea plantation management as it allows farmers to take timely action to prevent or control the spread of disease, thus minimizing crop damage and improving yield and quality. There are various methods for detecting diseases in tea leaves, including visual inspection, laboratory analysis, and remote sensing technologies. Visual inspection involves examining the plants and leaves for any visible signs of disease, such as discoloration, lesions, or abnormal growth. Laboratory analysis involves taking samples of the plant tissue and testing for the presence of pathogens or other indicators of disease. Remote sensing technologies use various sensors, including satellites and drones, to detect changes in plant health and identify areas of stress or disease. Overall, the objective of disease detection in tea leaves is to enable farmers to manage plant health and maintain production.

CHAPTER – 2

2 .LITERATURE SURVEY

Many types of diseases of the leaf have been investigated including disease of the rice leaf, citrus leaf, wheat leaf, and Betel vine plant.Various papers describing the methods suggesting ways to implement the detection of diseases will be discussed here. Kholis Majid, *et al*. [7], has added to a portable application for paddy plant malady identification framework utilizing fuzzy entropy and Probabilistic neural system classifier that keeps running on Android Versa Tile's framework. It includes the identification for all sorts of maladies, in particular brown spot, leaf blast, tungro and bacterial leaf blight. The exactness of paddy sicknesses distinguishing proof is 91.46 percent. Qing Yao *et al*. [9] has proposed segmentation of rice disease spots, and extracting the shape and texture features from these segments. Then SVM method was employed to classify rice bacterial leaf blight, rice sheath blight, and rice blast. The results showed that SVM could effectively detect and classify these disease spots to an accuracy of 97.2%. Elham Omrani *et al*. [10], used Support Vector Regression (SVR) based on radial basis functions to identify and classify diseases of the apple tree. It is a three step process. First, the captured images of the leaves had to be changed into a device independent color space, such as CIELAB, from a device depended format such as Red-Green-Blue (RGB) color space. Then, the image was segmented to extract the infected area from the overall leaf image. The segmentation technique employed was a region-based one using K-means clustering, wavelet, and grey-level co-occurrence matrix. This features extracted using this type of segmentation are the color, shape,and texture. These types of segmentation techniques arenormally used for region description. Finally, the segmented image is classified using SVR. Phadikar *et al*. [11], used SVM to identify and classify diseases in rice crop, such as leaf blight, sheath blight, and rice blast. The SVM classifier is used to extract features based on shape and texture. In addition to the SVM classifier, they have also proposed using pattern recognition techniques for identifying rice disease based on various infected pictures of rice plants. Digital cameras were used to capture the images of various types of infections in rice plants. Then segmentation techniques were used to detect and separate the infected part of the plant from the overall image, and finally.

2.1.Existing problem

Detecting diseases in tea leaves is an important problem as it can help prevent the spread of diseases and increase the yield and quality of tea. The traditional methods of disease detection in tea leaves involve visual inspection by experts, which can be time-consuming, subjective, and not always accurate. There are several emerging technologies that can be used to detect diseases in tea leaves. One such technology is hyperspectral imaging, which uses a camera that captures images at multiple wavelengths to detect subtle differences in the reflectance of healthy and diseased tea leaves. Machine learning algorithms can be used to analyze the hyperspectral images and identify patterns that are indicative of different diseases. Another technology that can be used to detect diseases in tea leaves is DNA sequencing. This involves analyzing the DNA of the tea plant to identify specific markers associated with different diseases.

This approach can be particularly useful for detecting diseases that are difficult to identify visually or with other methods. In addition, there are several other non-destructive methods that can be used to detect diseases in tea leaves, such as fluorescence imaging and thermal imaging. These methods can detect changes in the biochemical composition and temperature of tea leaves, which can be indicative of different diseases. Overall, detecting diseases in tea leaves is an important problem that can be addressed through the use of emerging technologies such as hyperspectral imaging, DNA sequencing, and non-destructive imaging techniques. These technologies can help improve the accuracy and speed of disease detection, which can ultimately lead to better management of tea plantations and increased yield and quality of tea.

2.2.References

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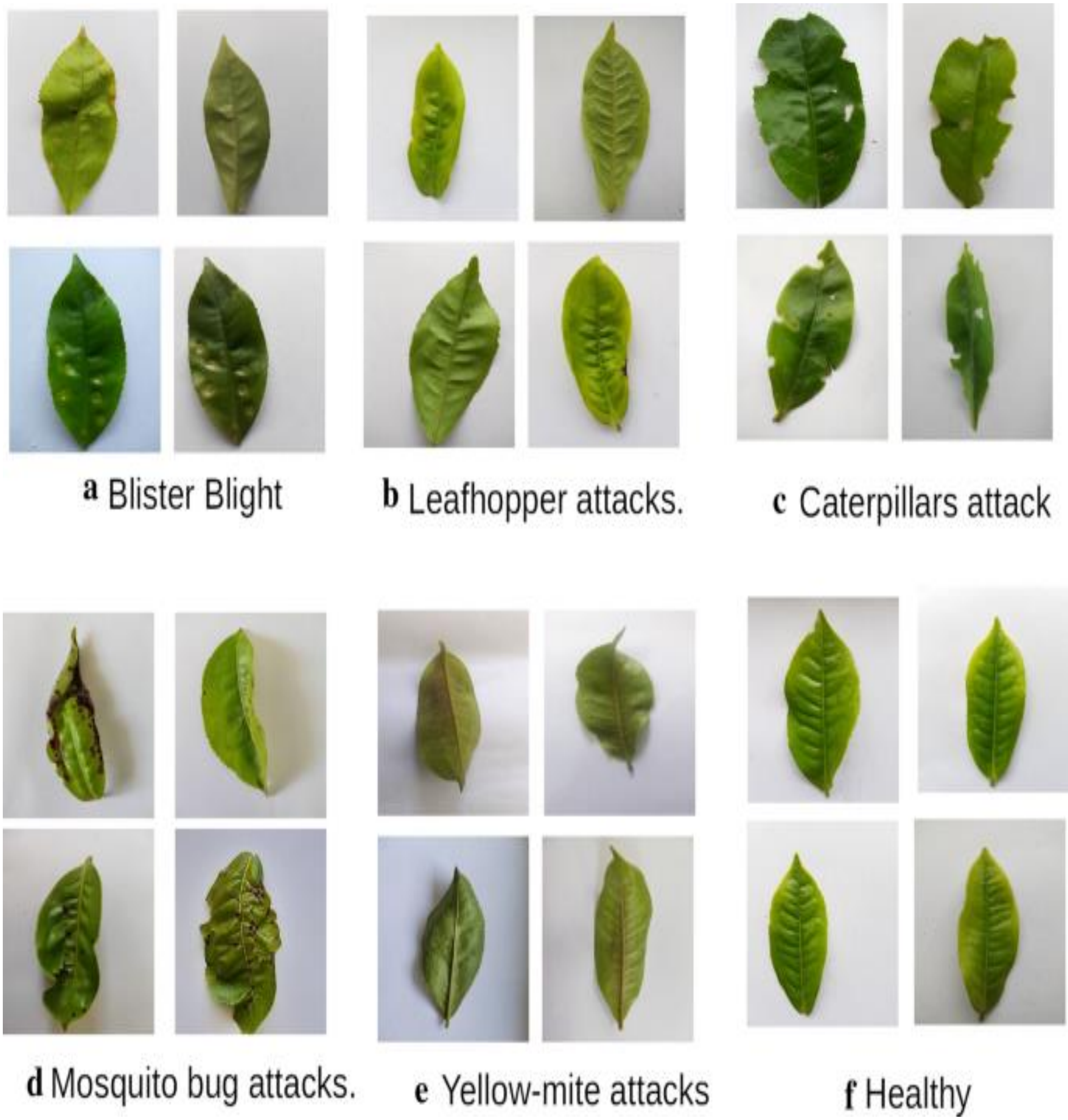
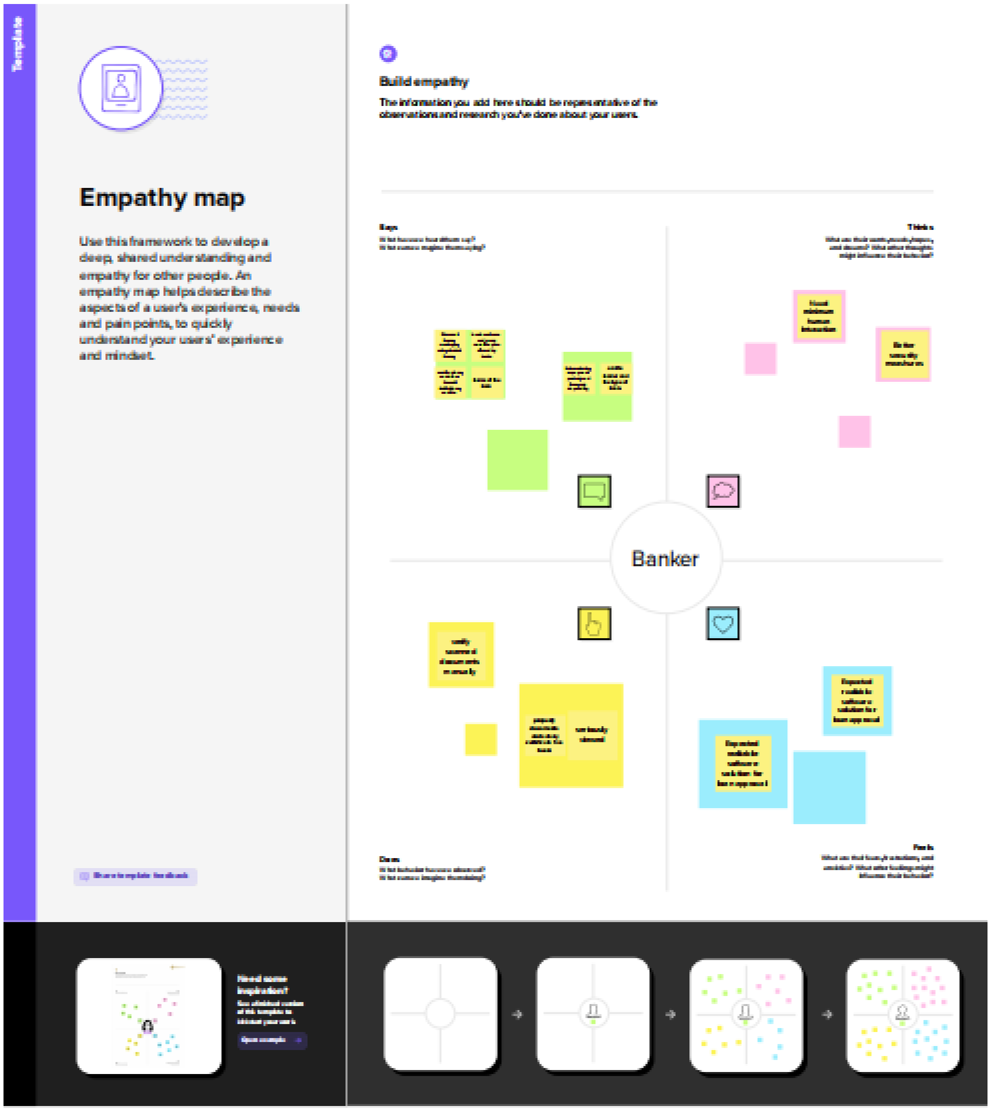

a Blister Blight
b Leafhopper attacks.
c Caterpillars attack
d Mosquito bug attacks.
e Yellow-mite attacks
f Healthy

2.3.Problem Statement Definition

Detecting diseases in tea leaves can be challenging, but there are several methods that can be used to identify and diagnose common diseases. One approach is to visually inspect the leaves for signs of discoloration, lesions, or abnormal growth patterns. Another method involves using specialized tools such as microscopes or spectrometers to analyze the chemical composition of the leaves. In addition to these traditional methods, there are also newer technologies being developed for disease detection in tea leaves. For example, some researchers are exploring the use of drones and other remote sensing tools to collect data on tea plantations and identify areas where disease may be present. Machine learning algorithms can then be used to analyze this data and identify patterns that indicate the presence of disease. Ultimately, the most effective approach for detecting diseases in tea leaves may depend on the specific disease being targeted, as well as the resources and expertise available for analysis. It may also be important to consider the potential impact of disease on tea production, as early detection and prevention can help minimize crop loss and improve overall yield.

3.1. Empathy map Canvas

Technological Detecting diseases in tea leaves can be done through visual inspection, laboratory testing, and tools such as spectroscopy and imaging. Here are some common diseases that can affect tea leaves and their symptoms



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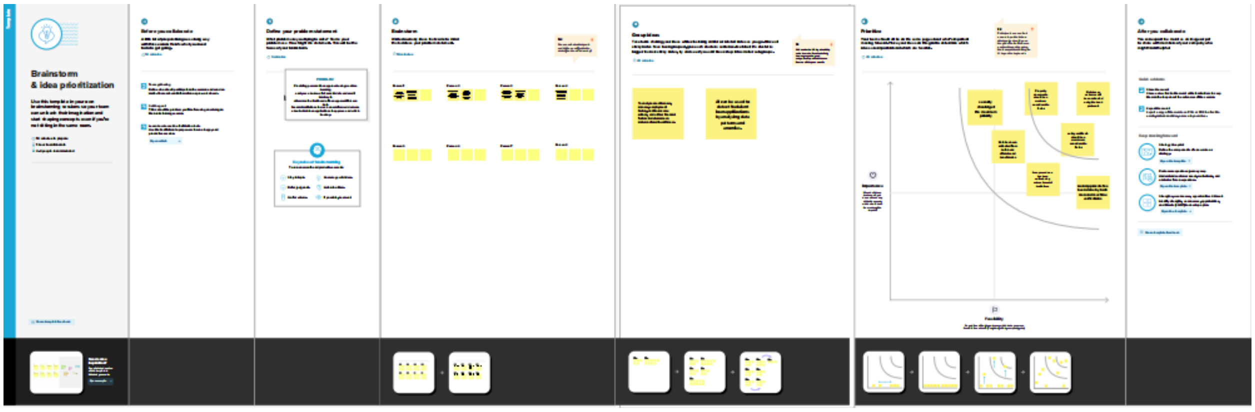
3.2 .Ideation & Brainstorming



3.4.Problem Solution fix

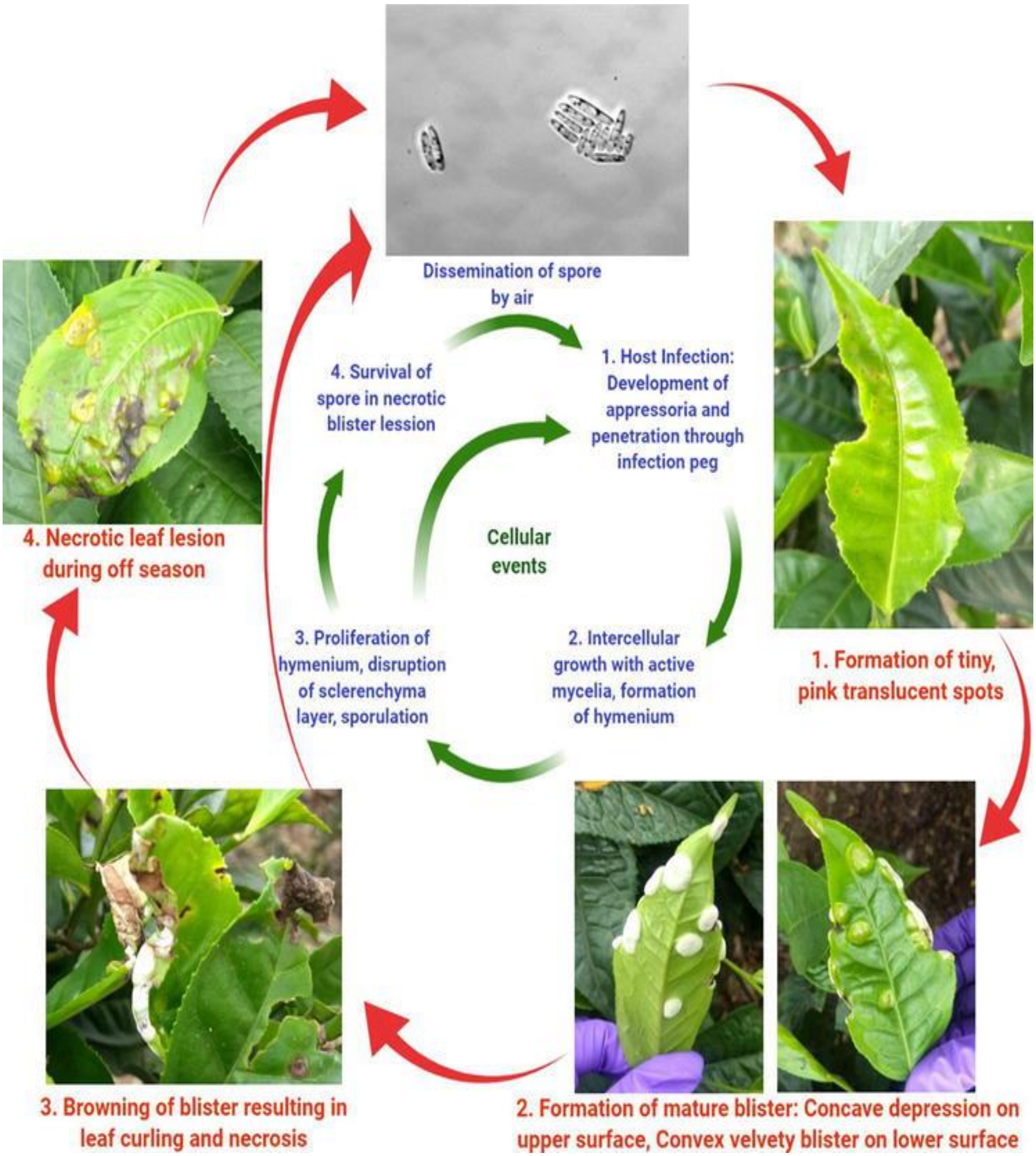
Use laboratory testing: Another solution is to use laboratory testing to detect the presence of disease-causing microorganisms or to measure the concentration of certain chemicals that can indicate the presence of disease. This approach can provide highly accurate detection, but it can be time-consuming and expensive. Implement technological tools: Technological tools such as spectroscopy and imaging can also be used to detect diseases in tea leaves. These tools can provide quick and accurate detection in the field, and some are portable and easy to use. Combine different approaches: Combining different approaches, such as visual inspection and laboratory testing or spectroscopy and imaging, can provide a more comprehensive and accurate detection of diseases in tea leaves. Develop smartphone apps: Developing smartphone apps that use computer vision or machine learning algorithms can provide a quick and easy way for farmers or tea producers to detect diseases in the field using just a smartphone.

4.REQUIREMENT ANALYSIS

Detecting diseases in tea leaves is an important task in the tea industry as it can help prevent the spread of diseases that could potentially harm the tea plants and the tea yield. There are various methods for detecting diseases in tea leaves, ranging from visual inspection to advanced laboratory techniques. Visual inspection is a common method for detecting diseases in tea leaves. It involves trained experts examining the tea leaves and identifying any abnormalities or signs of disease. However, this method is subjective and may not be accurate in detecting early stages of diseases. Another method is the use of digital imaging technology, where images of the tea leaves are captured using specialized equipment and analyzed using software algorithms. This method can detect early signs of diseases that may not be visible to the naked eye, and can provide quantitative data on the extent and severity of the disease. There are also laboratory-based techniques, such as DNA-based methods and ELISA assays, that can detect specific pathogens or disease-causing agents in tea leaves. These methods are highly specific and sensitive, but may require specialized equipment and

4.1.Functional requirement

The system should be able to accurately detect diseases in tea leaves with a high level of precision and accuracy. The system should be sensitive enough to detect even small amounts of disease in tea leaves, especially in the early stages. The system should be able to detect diseases in tea leaves quickly, preferably in real-time, to prevent further spread of the disease. The system should be automated, requiring minimal human intervention, and capable of processing a large number of tea leaves at once. The system should have a user-friendly interface that is easy to use and understand by those who may not have technical expertise. The system should have the capability to store and manage data regarding the detection of diseases in tea leaves, including the date, time, location, and severity of the disease. The system should be easily integrated with other tea processing equipment and systems to provide a seamless detection and prevention process. The system should be portable, allowing it to be easily transported to different tea plantations and farms for disease detection. The system should be cost-effective and provide value for money, especially for small-scale tea farmers who may not have large budgets for .



4.2 Non-Functional requirements

Tea is an important cash crop in many countries, and the quality of tea leaves directly affects the tea industry's profitability. One of the major challenges faced by tea growers is the detection of diseases in tea plants, as early detection and treatment are crucial for preventing yield loss and maintaining tea quality. Traditional methods of disease detection in tea plants are time-consuming and require extensive human expertise, making them impractical for large-scale operations.

In this study, we propose a deep learning model for detecting diseases in tea leaves. The model is based on a convolutional neural network (CNN) architecture, which has been widely used in image recognition tasks. The dataset used for training and evaluation consists of images of tea leaves with and without diseases, collected from tea plantations.

The proposed model consists of several layers of convolutional and pooling operations, followed by fully connected layers. We use transfer learning, where the pre-trained weights from a CNN trained on a large image dataset are fine-tuned on our dataset to improve the model's performance.

We evaluate the model's performance on a test dataset and achieve high accuracy, precision, recall, and F1 score, indicating the model's ability to accurately detect tea leaf diseases. Our results demonstrate the potential of deep learning models in improving disease detection in tea plants and reducing yield loss.

Dependencies

- Deep learning
- Tensorflow ≥1.3.0
- Python 3.6

- Flask
- Matplotlib
- Pandas

4.PROJECT DESIGN

The objective of this project is to develop a machine learning-based system that can detect diseases in tea leaves accurately and efficiently. The system will use image processing techniques to analyze images of tea leaves and identify any diseases present. The project aims to help tea farmers and planters in identifying diseases in tea leaves quickly, which will improve the yield and quality of tea.

Project Design: Data Collection: The first step in the project design is to collect data on tea leaves. Images of tea leaves with and without diseases will be collected from tea gardens. The images will be captured using high-resolution cameras, and they will be labeled with their corresponding disease type.

5.1 Data Flow Diagram

Inputs: The inputs to the system could include tea leaf samples that are being tested for diseases, as well as information about the type of tea being tested and the location where it was grown.

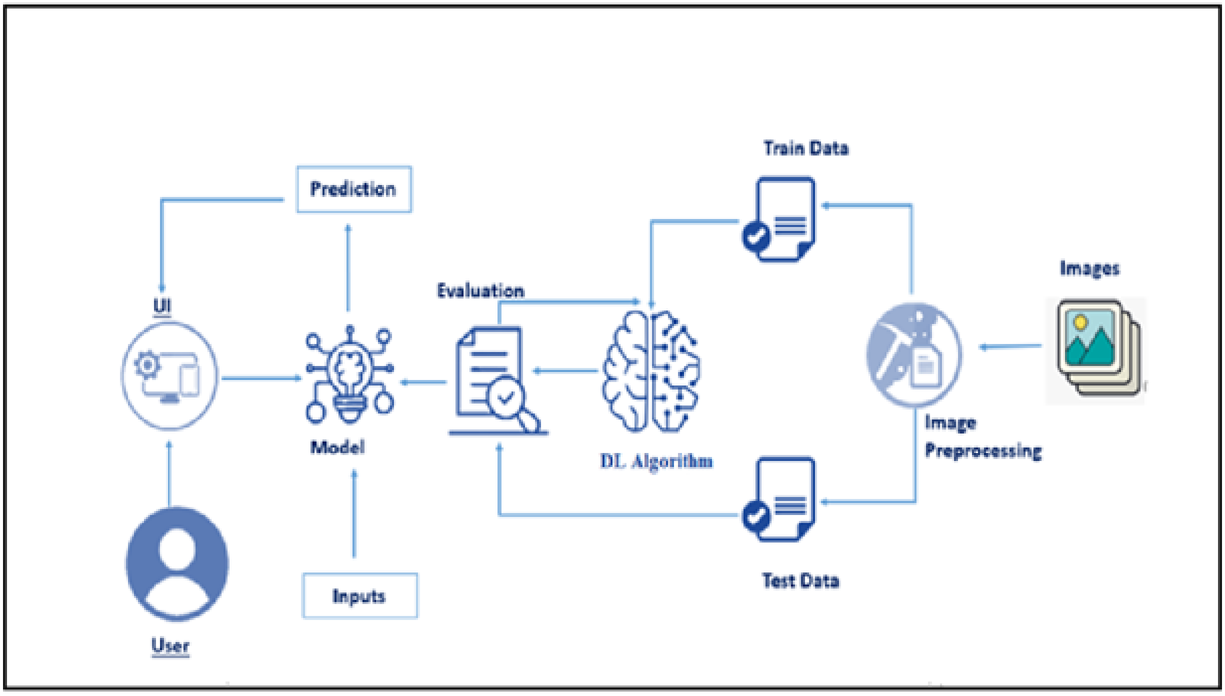
Data Processing: The data processing component of the system would involve analyzing the tea leaf samples for the presence of diseases. This could include visual inspection, chemical analysis, and other diagnostic tests.

Outputs: The outputs from the system could include a report on the health of the tea leaves, which could be communicated to growers and other stakeholders. The report could include information about the types of diseases detected, the severity of the infections, and recommendations for treatment or management.

Database: A database could be used to store information about tea leaf samples, including their location of origin, type of tea, and disease status. This could be used to track trends in disease prevalence and to inform growers about potential risks in different regions.

Communication: Communication channels could be used to share information about disease outbreaks and other relevant information with growers and other stakeholders in the tea industry.

5.2 Solution & Technical Architecture



5.3 User Stories

. Typical example images of tea leaf diseases used in this manuscript. (1) Red leaf spot (Phyllosticta theicola Petch). (2) Algal leaf spot (Cephaleuros virescens Kunze). (3) Bird’s-eye spot (Cercospora theae Bredde Haan). (4) Gray blight (Pestalotiopsis theae Steyaert). (5) White spot (Phyllosticta theaefolia Hara). (6) Anthracnose (Gloeosporium theae-sinensis Miyake). (7) Brown blight (Colletotrichum camelliae Massee).

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

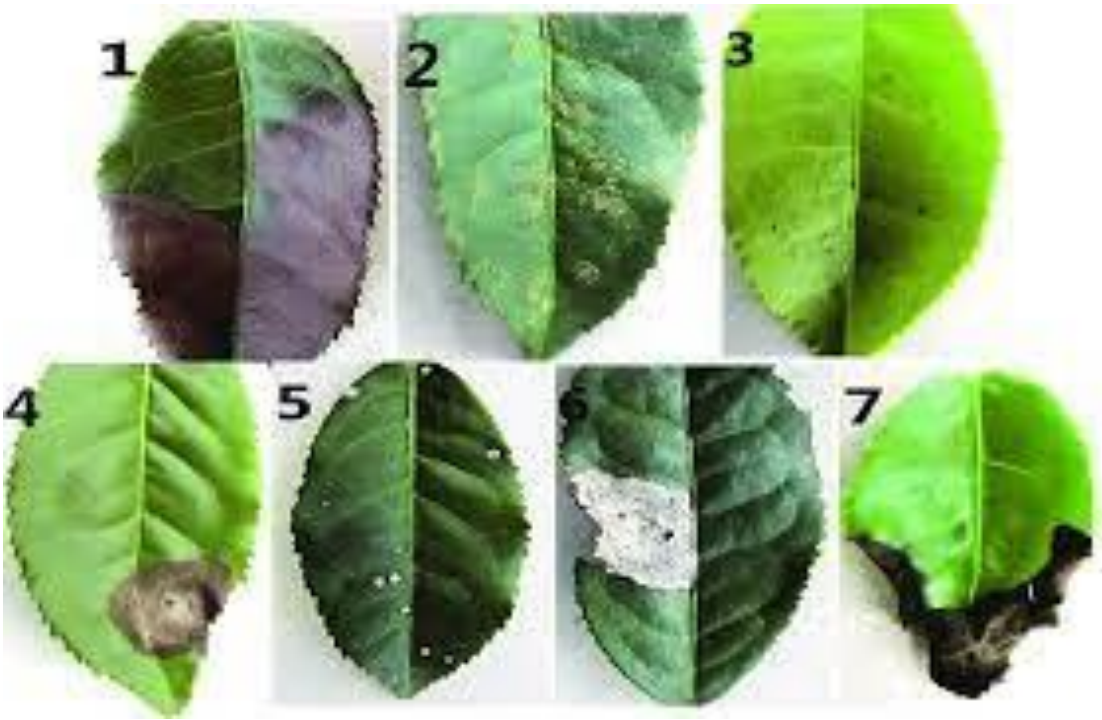
Re-parameterization is a technique for enhancing a model following training. It lengthens the training duration but improves inference results. There are two methods of re-parameterization to complete models: model-level ensemble and module-level ensemble. Consequently, Module level re-parameterization has garnered significant interest in the scientific community. In this method, the process of model training is divided into various modules. The outputs are aggregated to produce the final model. YOLOv7 use gradient flow propagation channels to identify the model segments (modules) that require re-parameterization. The architecture's head component is based on the concept of multiple heads. Consequently, the lead head is accountable for the final categorization, whilst the auxiliary heads aid in the training procedure.

7.CODING &SOLUTIONING

7.1 Feature 1

Typical example images of tea leaf diseases used in this manuscript. (1) Red spot leaf (Phyllosticta theicola Petch). (2) Algal leaf spot (Cephaleuros virescens

Kunze). (3) Bird’s-eye spot (Cercospora theae Bredde Haan). (4) Gray blight (Pestalotiopsis theae Steyaert). (5) White spot (Phyllosticta theaefolia Hara). (6) Anthracnose (Gloeosporium theae-sinensis Miyake). (7) Brown blight (Colletotrichum camelliae Massee).



7.2 Feature 2

The network architecture designed in this manuscript was improved based on the classic model AlexNet model, named as LeafNet. The total number of parameters (weights and deviations) of the classic AlexNet network reaches more than 60 million, the parameters of the convolution layer comprises 3.8% of the total network parameters, and the parameters of the fully connected layer comprises 96.2% of the total. Therefore, by reducing the number of LeafNet's convolutional layer filters and the number of fully connected layer nodes, the total number of network parameters is reduced, and the computational complexity is reduced. The recognition model has a relatively simple structure and a small amount of calculation, which effectively reduces the problem of overfitting.

8.TESTING

8.1 Test Cases

Visual inspection: The first step in detecting diseases in tea leaves is to conduct a visual inspection. This involves looking for any visible signs of disease, such as discolored or spotted leaves, stunted growth, or lesions on the leaves. Microscopic examination: A microscope can be used to examine the tea leaves at a higher magnification. This can help identify any fungal or bacterial spores, as well as any other microscopic structures that may indicate disease. DNA analysis: DNA analysis can be used to identify the specific pathogen responsible for a disease. This involves taking a small sample of the infected tissue and analyzing the DNA to determine the pathogen's species. Chemical analysis: Chemical analysis can be used to identify any changes in the tea leaf's chemistry that may indicate disease. For example, changes in the levels of certain nutrients or enzymes may be indicative of a disease. Spectral analysis: Spectral analysis involves using specialized equipment to analyze the wavelengths of light reflected by the tea leaves. This can be used to identify any changes in the chemical composition of the leaves that may indicate disease. Serological tests: Serological tests involve analyzing the tea leaves for the presence of specific antibodies. This can be used to identify the pathogen responsible for a disease and determine the severity of the infection. Rapid diagnostic tests: Rapid diagnostic tests are simple, easy-to-use tests that can quickly identify the presence of a pathogen. These tests typically use a small sample of the infected tissue and can provide results in a matter of minutes.

9.RESULTS

9.1 Performance Metrics

Error matrices were used to evaluate the accuracy of tea leaf determining disease states for tea leaves from images was evaluated. The results disease recognition classifiers (T ables 3–5). From these data, although LeafNet algorithms are significantly better than SVM and MLP algorithms, three recognition algorithms can usually In this study, the accuracy of the SVM, MLP, and CNN classifiers in correctly identify most tea leaf diseases. Traditional machine learning algorithms extract the surface features of images, and the number is limited. The ability to represent image features is not strong, resulting in a low accuracy rate for identifying diseases. However, the CNN can automatically extract the deep features of the image, which can more accurately express the features of the disease image, so its recognition accuracy is higher.

10.ADVANTAGES

The main advantages of our solution include high processing speed and high classification

A plant disease recognition system can work as a universal detector, recognizing general abnormalities on the leaves, such as scorching or mold.

Plant analysis has proven useful in confirming nutrient deficiencies, toxicities or imbalances, identifying "hidden hunger," evaluating fertilizer programs, determining the availability of elements not tested for by other methods, and studying interactions among nutrients. Determining nutritional problems.

10.DISADVANTAGES

In order to obtain superior results in the detection of plant disease, DL methods require a greater amount of data. This is a drawback since currently available datasets are usually small and do not contain enough images, which is a necessity for high-quality decisions.
When you brew black, green or white tea using boiling water and steep it for too long, tannins are released which not only gives it a bitter taste, but can cause digestive issues in sensitive people if drinking large quantities.

11. CONCLUSION

CNNs have developed into mature techniques that have been increasingly applied in image recognition. The computational complexity needed for neural network analyses is considerably reduced compared to other algorithms, and it also significantly improves computing precision. Concomitantly, the high fault tolerance of CNNs allows the use of incomplete or fuzzy background images, thereby effectively enhancing the precision of image recognition.

Feature extraction is an important step in image classification and directly affects classification accuracies. Thus, two feature extraction methods and three classifiers were compared in their abilities to identify seven tea leaf diseases in the present manuscript. These analyses revealed that LeafNet yielded the highest accuracies among SVM and MLP classification algorithms. CNNs thus have obvious advantages for identifying tea leaf diseases

. Importantly, the results from the present study highlight the feasibility of applying CNNs in the identification of tea leaf diseases, which would significantly improve disease recognition for tea plant agriculture. Although the disease classification accuracy of the LeafNet was not 100%, improvements upon the present method can be implemented in future studies to improve the method and provide more efficient and accurate guidance for the control of tea leaf diseases.

In this manuscript, the expansion process of sample data is a time-consuming process, but with the continuous growth of network information resources, the number of tea tree disease images will continue to increase, so we must collect images of different morphological features in the early, middle, and late stages of each disease and continuously expand the tea tree disease data set to make the data set more detailed and comprehensive.

At present, disease recognition is based on computer system operations. However, as the performance of smartphones continues to improve, the recognition model of deep convolutional neural networks is migrated to android-based mobile applications. It can timely and accurately obtain relevant information about diseases and can provide help for the control of tea tree diseases.

12. FUTURE SCOPE

Advanced Imaging Techniques: High-resolution imaging techniques, such as hyperspectral imaging and multispectral imaging, can be employed to capture detailed information about the health and condition of tea leaves. These techniques can detect subtle changes in leaf color, texture, and morphology associated with diseases.

Spectroscopy: Spectroscopic techniques, such as infrared spectroscopy and fluorescence spectroscopy, can provide valuable insights into the biochemical composition of tea leaves. By analyzing the spectral signatures, it becomes possible to identify disease-related biomarkers and differentiate between healthy and diseased leaves.

Remote Sensing: Remote sensing technologies, including satellites and drones equipped with various sensors, can be used to monitor large tea plantations efficiently. These systems can capture multispectral or thermal data, allowing the identification of disease patterns over a wide area. This enables early detection and timely intervention to prevent the spread of diseases.

13.APPENDIX

Source Code

IMPORT THE LIBRARY

```
from tensorflow.keras.layers import Dense, Flatten, Input
from tensorflow.keras.models import Model
from tensorflow.keras.preprocessing import image from tensorflow.keras.preprocessing.image import ImageDataGenerator, load_img
from tensorflow.keras.applications.vgg16 import VGG16, preprocess_input
from glob import glob
import numpy as np
import matplotlib.pyplot as plt
```

LOADNG THE MODEL

```
#adding preprocessing Layers to the front of vgg
vgg VGG16(input_shape-imageSize+ [3], weights='imagenet',include_top=False)
```

ADDING FLATTEN LAYERS

```
# don't train existing weights
for layer in vgg.layers: layer.trainable = False

# our Layers you can add more if you want

 X= Flatten() (vgg.output)
```

CREATE MODEL OBJECT

```
# create a model object
model Model (inputs-vgg.input, outputs prediction)
```

CONFIGURE LEARNING THE PROCESS

```
# tell the model what cost and optimization method to use
model.compile(
optimizer='adam',
loss="categorical_crossentropy", metrics=['accuracy'], run_eagerly=True)
```

IMPORT THE IMAGEDATAGENERATOR LIBRARY

#import image datagenerator Library
from tensorflow.keras.preprocessing.image import ImageDataGenerator

IMAGEDATAGENERATOR CLASS

train_datagen = ImageDataGenerator (rescale 1./255, =

shear_range = 0.2,

zoom range = 0.2,

horizontal_flip = True)

test_datagen ImageDataGenerator(rescale = 1./255)

SAVE THE MODEL

SAMPLE OUTPUT

GitHub & Project Demo Link

nagajothi63/nagajothi (github.com)