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DETECTION OF DISEASES IN TEA LEAVES USING CONVOLUTIONAL NEURAL NETWORK

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***Abstract**:* Tea leaves are susceptible to various diseases that can significantly impact the yield and quality of tea production. Early detection and diagnosis of these diseases are crucial for timely interventions and effective disease management. In recent years, deep learning techniques have shown promising results in automated image-based disease detection systems. This study investigates the application of pretrained convolutional neural networks (CNNs), specifically AlexNet and GoogLeNet, for tea leaves disease detection.

The pretrained AlexNet and GoogLeNet models are fine-tuned using a large dataset of labeled tea leaf images containing healthy leaves as well as leaves affected by common diseases. . The results demonstrate the effectiveness of using pretrained networks for tea leaves disease detection, with both AlexNet and GoogLeNet achieving high accuracies. Additionally, the models are compared in terms of computational efficiency and detection performance to determine their suitability for practical deployment.

Proposed methodology uses Tea Leaves Disease Classification dataset classify seven types of diseases like red leaf spot, gray blight, white spot, brown blight, algal leaf spot, Anthracnose, bird's eye spot each class contain minimum 40 images proposed methodology compute tea leaves diseases identification by using AlexNet and GoogleNet. The methodology proposed Convolutional Neural Network (CNN) to improve accuracy further experimental results show the detection and identification accuracy Of AlexNet and GoogleNet for tea Leaves diseases.

Index Terms **- Convolutional Neural Network; AlexNet; GoogleNet.**

I. INTRODUCTION

Tea is one of the most widely consumed beverages globally, and tea leaves play a crucial role in its production. However, tea plants are susceptible to various diseases that can significantly impact their growth, yield, and quality. Accurate detection and identification of these diseases are essential for precise prevention and control measures. In recent years, deep learning techniques, such as Convolutional Neural Networks (CNNs), have emerged as powerful tools for image-based disease identification in agricultural plant protection.

The proposed methodology aims to apply CNN models, specifically AlexNet, GoogleNet, and our custom-designed network, for the detection and classification of tea leaf diseases. The use of CNNs allows us to automatically extract relevant features from tea leaf images, enabling accurate disease identification. By leveraging the capabilities of these deep learning architectures, we seek to improve the efficiency and accuracy of tea leaf disease classification, which can ultimately contribute to effective disease management strategies in tea plantations.

AlexNet revolutionized the field of computer vision with its deep architecture and outstanding performance in the ImageNet Large Scale Visual Recognition Challenge. Proposed methodology utilize AlexNet as a benchmark model and evaluate its effectiveness in identifying various tea leaf diseases. By leveraging its deep Convolutional Layers and pooling operations, we expect AlexNet to capture intricate disease-related patterns and achieve high accuracy in disease classification.

Additionally, the proposed methodology will employ GoogleNet, also known as Inception v1, which incorporates the concept of inception modules to optimize the trade-off between network depth and computational efficiency. With its unique architecture and multiple parallel convolutional pathways, GoogleNet can efficiently extract both global and local features from tea leaf images, potentially enhancing disease detection accuracy.

Furthermore, the proposed methodology explores the development of our custom-designed CNN architecture tailored specifically for tea leaf disease classification. By carefully designing the network layers, incorporating appropriate activation functions, and leveraging transfer learning techniques, we aim to maximize the network's ability to extract relevant disease features and accurately classify tea leaf diseases.

Through this research, the proposed methodology seeks to compare the performance of AlexNet, GoogleNet, and our custom-designed network in detecting and classifying common tea leaf diseases. The results obtained will provide insights into the effectiveness of these CNN models for tea leaf disease identification and potentially contribute to the development of efficient disease management strategies in tea cultivation.

II. LITERATURE SURVEY

1. **"Plant diseases identification using shallow convolution neural network**:- Proposed methodology shows two methods shallow VGG with RF and VGG with Xgboost. One of the major advantages in the proposed model is that the model perform's better with fewer parameters comparison with VGG19 and other deep learning."[3]

Advantage - One of the major advantages in the proposed model is that, the model performs better with fewer parameters in comparison with VGG19 and other deep learning

Disadvantage- The parameter generated in this model is much higher, which implied the higher computational cost.

2. **"Automatic Recognition of tea diseases based on deep learning:-** Proposed methodology discussed about image feature extraction and description after obtaining the local feature vectors of all sample image and construct a visual vocabulary. Using vocabulary as a standard count the number of occurrences of each visual word in the image." [4]

Advantage - Gives real time performance and simple and easy to implement algorithm.

Disadvantage – 1. In this manuscript, the expansion process of sample data is a time-consuming process.

2. . Identify less plant diseases.

3. **"Plant detection and identification of tea leave diseases based on AX-Retina Net**:- Proposed methodody AX- Retina Net is constructed based on Retina Net by adopting and improved feature fusion module X-module and adopting a channel attention model[5]."

Advantage - Although RetinaNet achieved better results compared with the existing classical networks

Disadvantage - Some useful features will be missed, which will affect the detection and recognition effect of the networks

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Materials and Methods

1. Identify the Tea leaves diseases dataset.
2. Understand what is AlexNet and GoogleNet.
3. Proposed methodology uses Alexnet to Identifying Disease in Tea leaves dataset.
4. Proposed methodology uses GoogleNet to Identifying Diseases in Tea leaves dataset.
5. Proposed methodology compare the Alexnet and Googlenet accuracy.

III. ALGORITHMSAlexNet

1. Preprocessing

weight and preprocess your dataset of images.
Perform any necessary data addition, similar as resizing or cropping.

2. Network Creation
produce a new GoogLeNet network using the alexnet function.

3. Training Data
Split your dataset into training and substantiation sets.

4. Options and Training
Define training options using the trainingOptions serve.
Set the asked parameters similar as learning rate, optimization algorithm, and batch size. Train the network using the trainNetwork function, passing in your training data and training options.

5. Substantiation and delicacy
   estimate the performance of the trained network on the substantiation set. Calculate the delicacy.

GoogleNet

1. Preprocessing
   weight and preprocess your dataset of images.
   Perform any necessary data addition, similar as resizing or cropping.

2. Network Creation
   produce a new GoogLeNet network using the googlenet function.

3. Training Data
   Split your dataset into training and substantiation sets.

4. Options and Training
   Define training options using the trainingOptions serve.
   Set the asked parameters similar as learning rate, optimization algorithm, and batch size.
   Train the network using the trainNetwork function, passing in your training data and training options.

5. Substantiation and delicacy estimate the performance of the trained network on the substantiation set. Calculate the delicacy.

OwnNetwork

1. Preprocessing
   weight and preprocess your dataset of images.
   Perform any necessary data addition, similar as resizing or cropping.

2. Network Creation
   produce a new OwnNetwork using the OwnNetwork function.

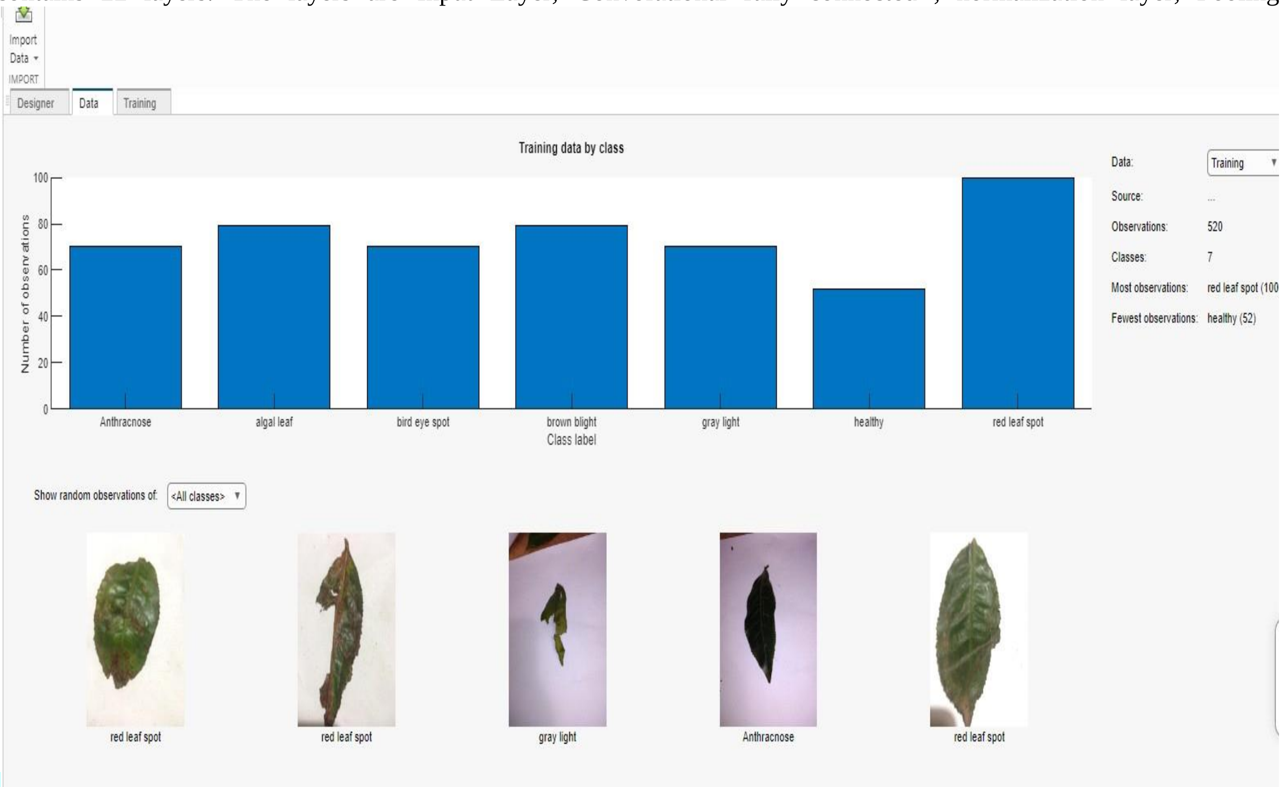
3. Training Data
   Split your dataset into training and substantiation sets.

4. Options and Training Define training options using the trainingOptions serve.
   Set the asked parameters similar as learning rate, optimization algorithm, and batch size.
   Train the network using the trainNetwork function, passing in your training data and training options.

5. Substantiation and delicacy
   estimate the performance of the trained network on the substantiation set. Calculate the delicacy.

IV. DATASET

Alexnet contains 22 layers. The layers are Input Layer, Convolutional fully connected , normalization layer, Pooling



Layer…etc

Figure 1: DataSet Classes

V. RESEARCH METHODOLOGY

Tea leaves disease detection using deep learning models like AlexNet and GoogLeNet is a promising approach that can help automate the process and improve the accuracy of disease identification. Here's a proposed system for tea leaves disease detection using these models:

1. Dataset Collection: Collect a diverse dataset of tea leaf images containing both healthy leaves and leaves affected by various diseases. Ensure that the dataset is labeled with the corresponding disease type for each image.

2. Data Preprocessing: Preprocess the tea leaf images to enhance the quality and prepare them for training. Common preprocessing steps include resizing the images to a consistent size, normalizing pixel values, and augmenting the dataset with techniques like rotation, flipping, and zooming to increase its diversity.

3. Model Selection: Choose the deep learning models to be used for disease detection. In this case, AlexNet and GoogLeNet are the chosen models. These models have demonstrated strong performance in image classification tasks.

4. Transfer Learning: Since training deep learning models from scratch on limited datasets can be challenging, leverage transfer learning. Initialize the AlexNet and GoogLeNet models with pre-trained weights on large-scale image datasets like ImageNet. This allows the models to learn general features and patterns from the pre-trained weights, which can then be fine-tuned for tea leaf disease detection.

5. Model Training: Split the preprocessed dataset into training, validation, and testing sets. Train the AlexNet and GoogLeNet models using the training set and validate their performance using the validation set. Adjust hyperparameters, such as learning rate and batch size, to optimize the models' performance.

6. Model Evaluation: Evaluate the trained models to assess their accuracy, precision, recall, and other relevant metrics.

VI . Convolutional Neural Network Architecture

- A convolutional layer.
- A pooling layer.
- A fully connected layer.
- Dropout layer.

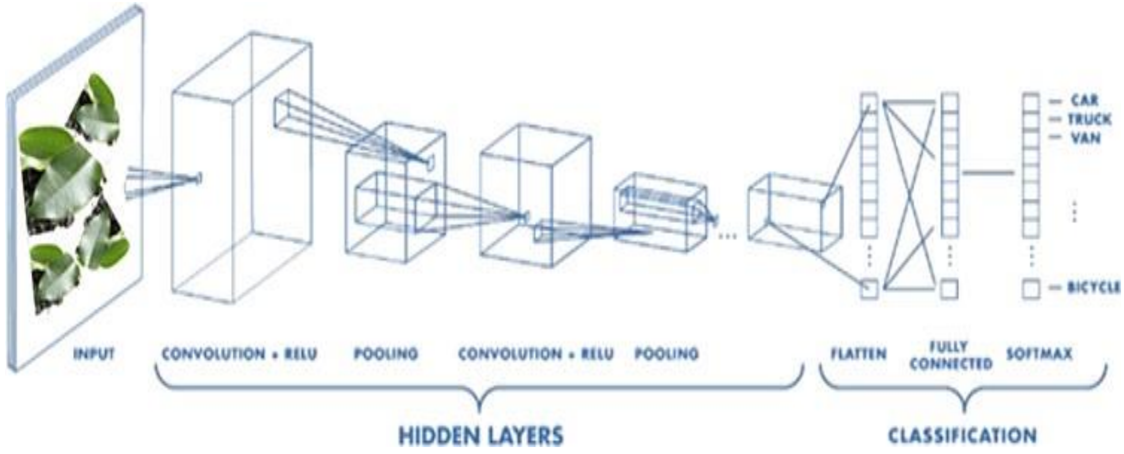


Figure 2: Convolution Neural Network Architecture

VI . 1 Convolution Layer

Convolution Layer The complication estate is the core structure block of the CNN. It carries the main portion of the network calculation weight. This estate performs a fleck product between two matrices where one matrix is the set of learnable parameters else known as a kernel and the other matrix is the defined portion of the open field. The kernel is spatially lower than an image, but is more in- depth. This means that if the image is composed of three channels the kernel height and range will be spatially small but the depth extends up to all three channels.

Figure 3: convolutional layer

VI . 2 Pooling Layer

The pooling estate replaces the affair of the network at a certain position by inferring a summary statistic of the near affair. This helps in reducing the spatial size of the representation which decreases the demanded quantum of calculation and weights. The pooling operation is reused on every slice of the representation collectively. There are several pooling functions similar as the normal of the blocky neighborhood, and a weighted normal rested on the distance from the central pixel. still, the most popular process is maximum pooling which reports the maximum affair from the neighborhood.

1. Max pooling

This works by concluding the maximum cost from every pool. Max pooling retains the maximum distinguished features of the characteristic chart, and the returned picture is sharper than the authentic picture.

2. Average pooling

This pooling estate plant by getting the common of the pool. Average pooling retains the common values of functions of rt. It smoothes the snap while retaining the substance of the function in an image.

Why pooling layers are demanded?

The function chart produced with the aid of the pollutants of convolutional layers is ase, if an object in an image has shifted a clump it might not be recognizable via the convolutional estate. So, it's manner that the point chart statistics the proper positions of features within they enter. What pooling layers offer is " translational invariance " which makes the cnn steady to translations,i.E., indeed supposing the input of the CNN is paraphrased, the cnn will still be suitable to fete the capabilities in the input.

VI. 3 Fully Connected Layer

Neurons in this estate have full connectivity with all neurons in the antedating and succeeding layers as seen in regular FCNN. This is why it can be reckoned as usual by a matrix addition followed by a bias effect. The FC estate helps to machinate the representation between the input and affair. A linked estate multiplies the input through a weight matrix after which provides a bias vector. The convolutional(and down- slice) layers are observed through one or further fully connected layers. As the call suggests, all neurons in a completely combined estate hook up with all of the neurons within the preexisting estate.

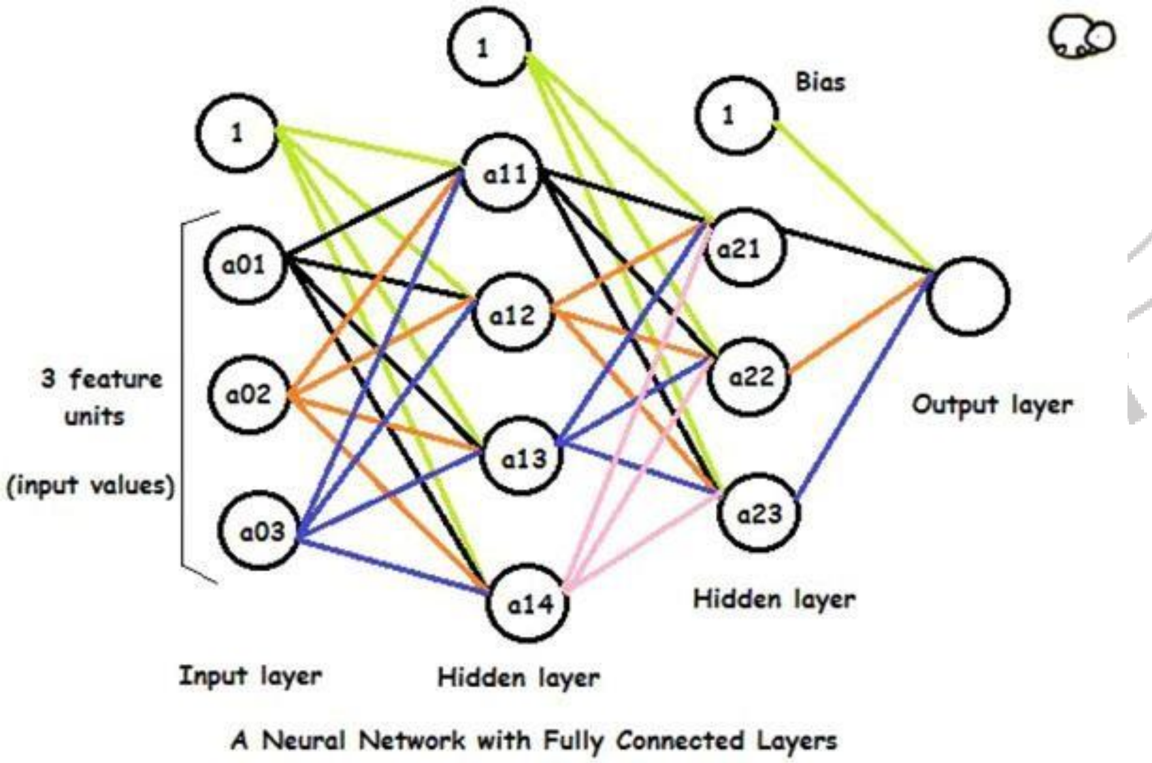


Figure 4 : completely Connected estate

VI . 4 Dropout Layer

Dropout is a regularization fashion used to lessenover- fitting on neural networks. Generally, deep studying fashions use hustler on the linked layers but is likewise possible to use hustler after the outside- pooling layers, developing print noise addition. Hustler aimlessly zeroes some of the connections of the enter tensor with chance p using samples from aBernoulli distribution.

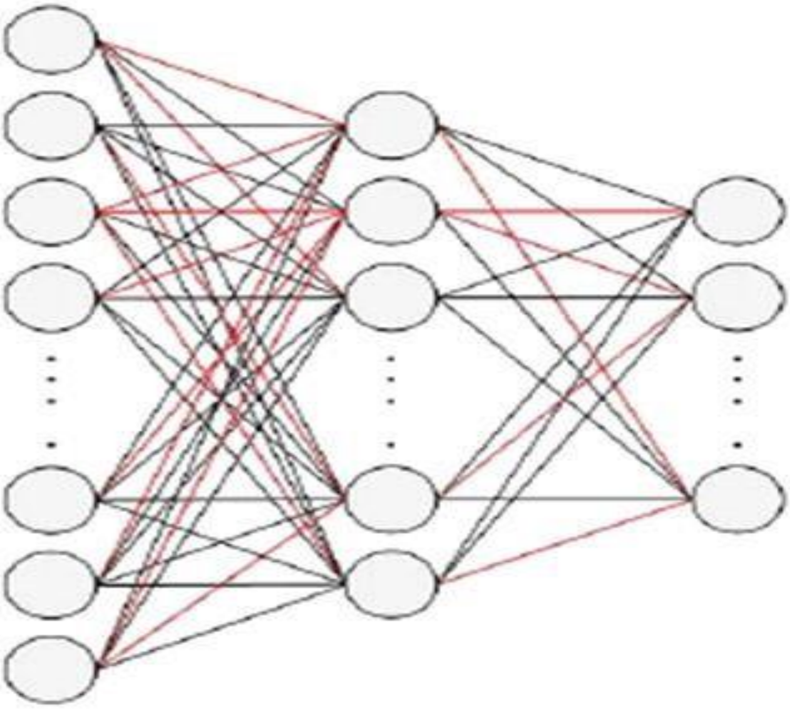


Figure 5: Dropout Layer

VI . 5 Relu(Rectifier direct unit) Activation function

Activation features introducenon- Linearity to the model which allows it to dissect complicated useful mappings among the inputs and response variables. There are fairly some exclusive activation features like sigmoid, tanh, relu, thick relu, and so on. Relu function is a piecewise direct point that labors they enter directly ifiseffectivei.E.> 0, else, it will affair zero. There are numerous other activation functions still relu is the most habituated activation function for numerous kinds of neural networks as because of its direct gesteit's lower delicate to educate, and it regularly achieves advanced performance.

ReLU(x)=max(0,x)

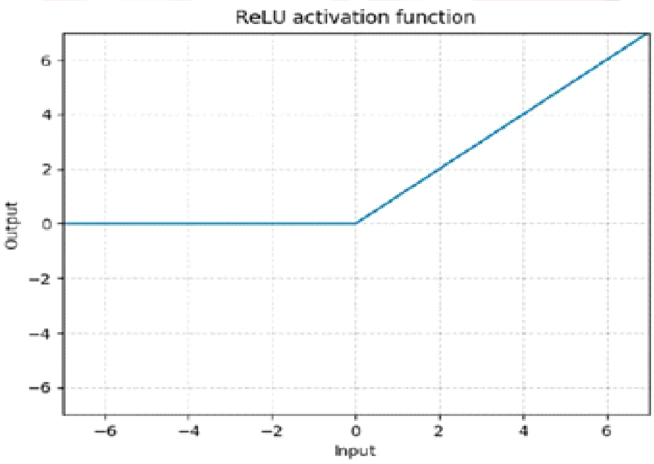


Figure 6 : Relu

VII . SYSTEM ARCHITECTURE

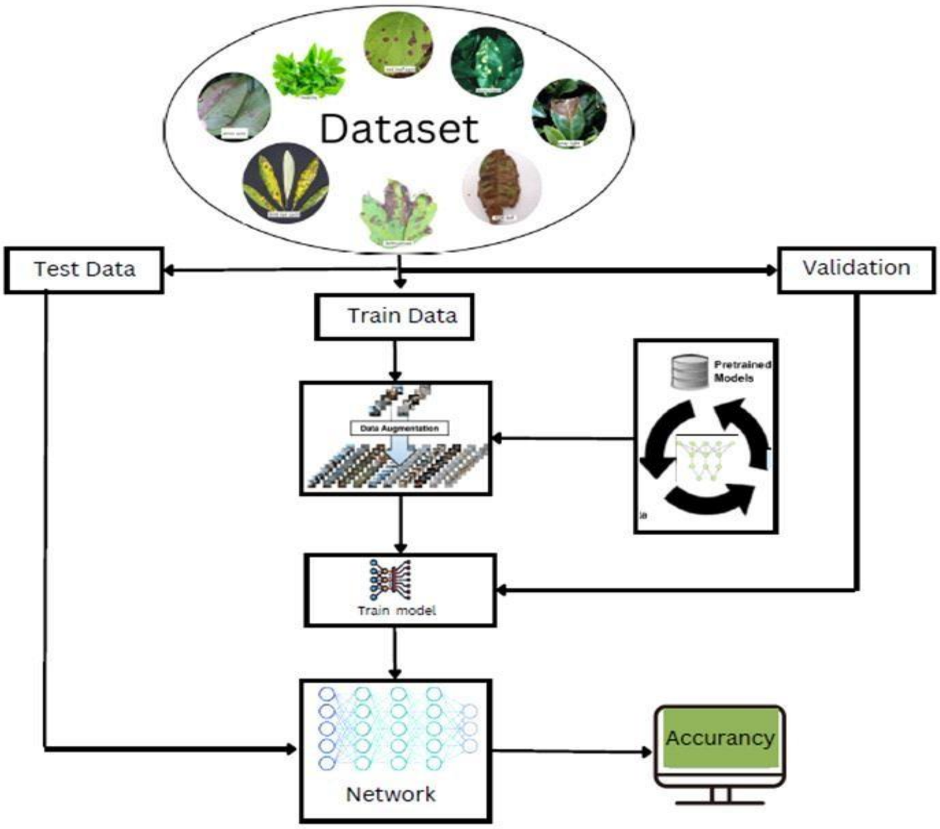


Figure 2: System Architecture

VIII . RESULTS AND DISCUSSION

ALEXNET

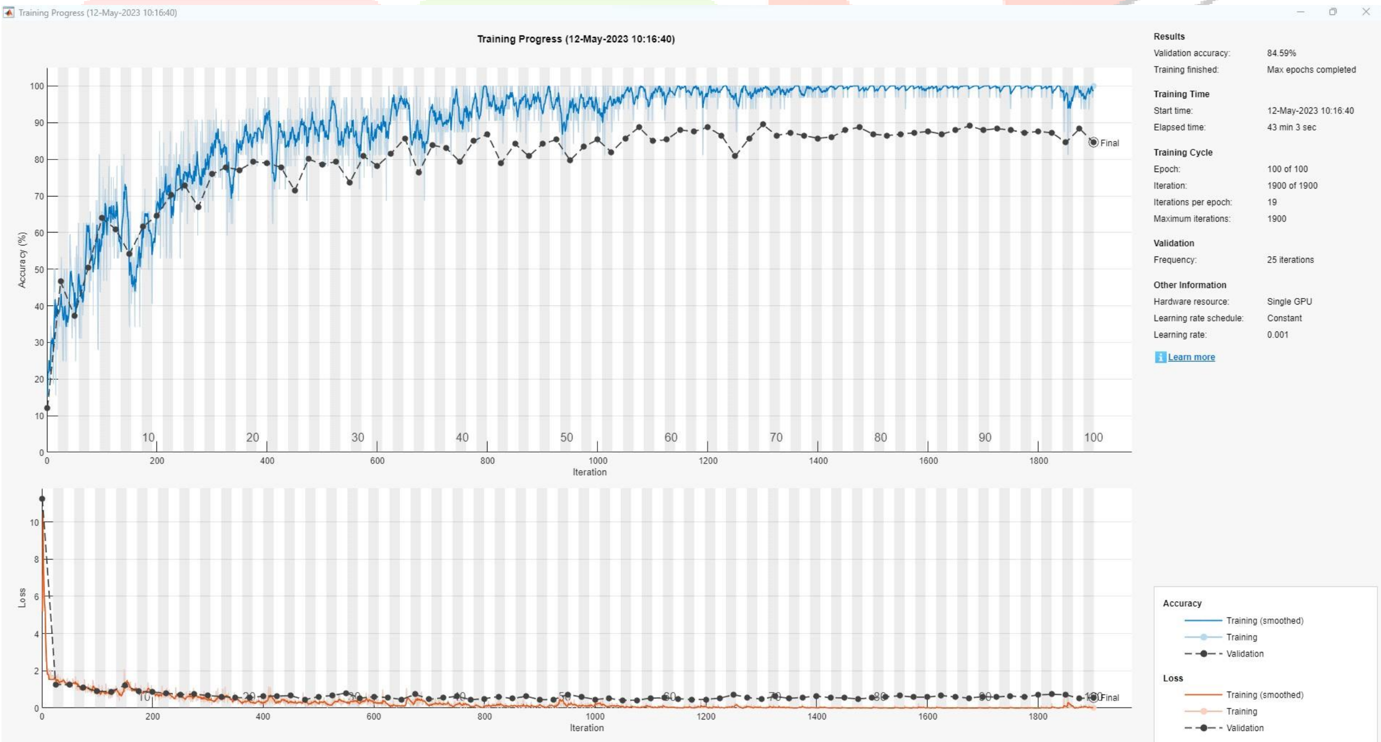


Figure: 3 AlexNet

accuracy = 0.8459

GOOGLE NET

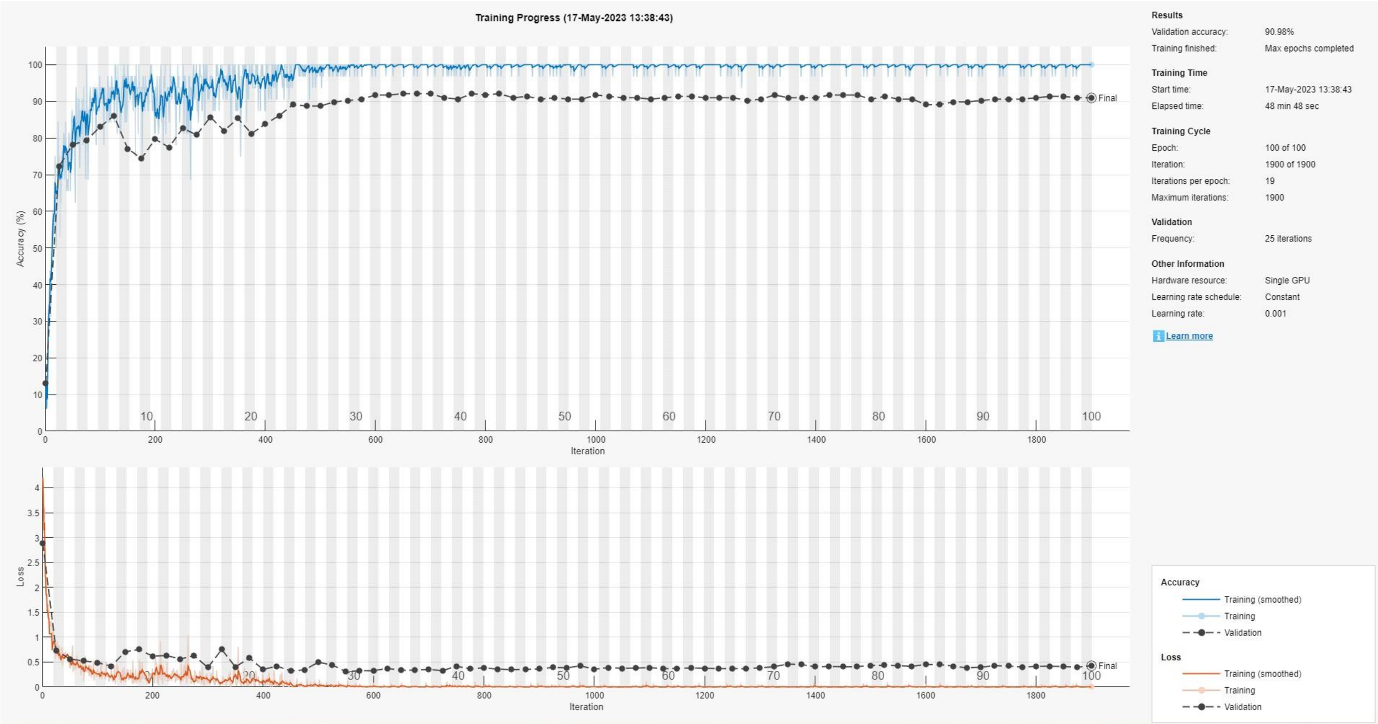
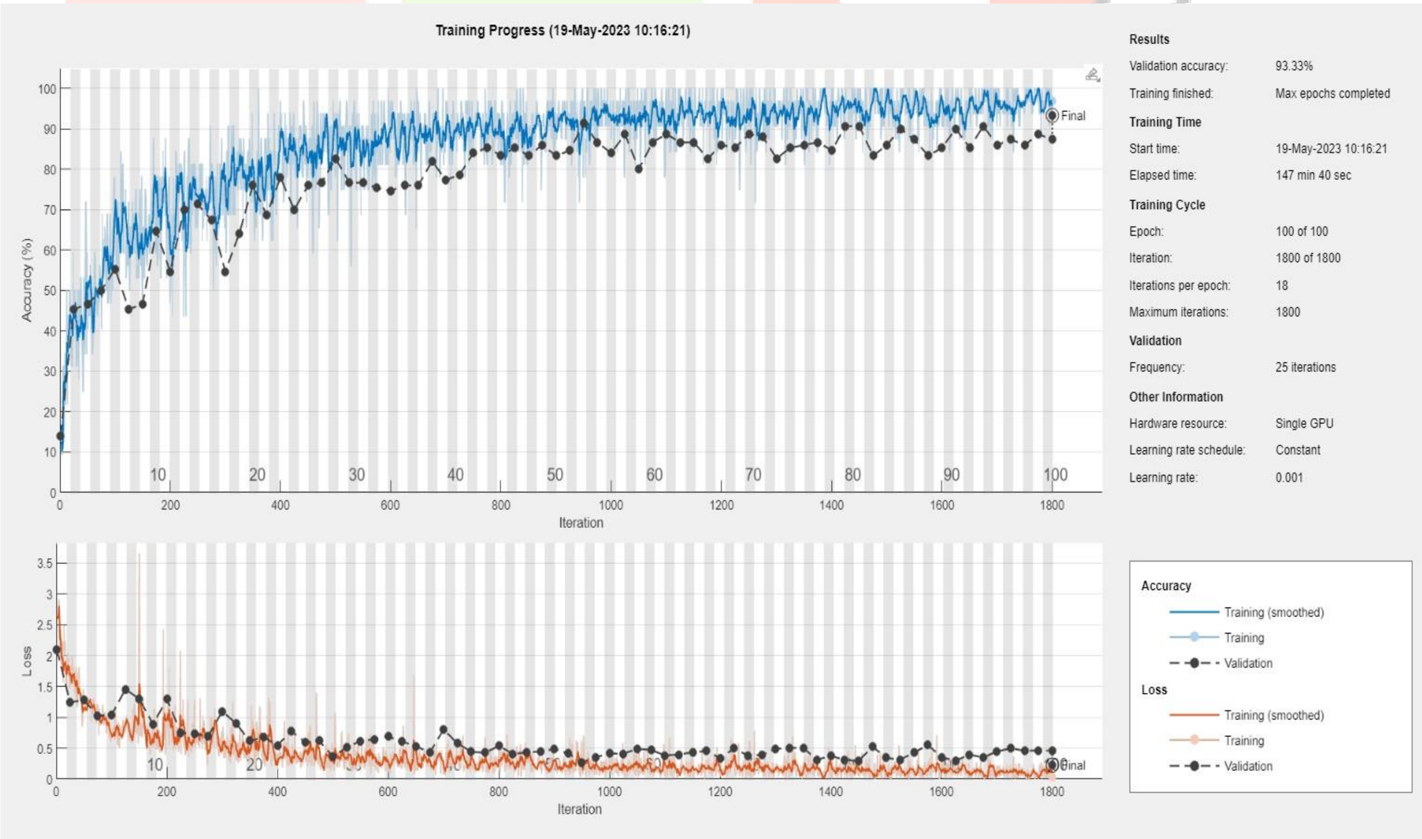


Figure: 4 AlexNet

Accuracy = 0.9098

OwnNetwork



Accuracy = 0.9333

IX . Precision, Recall values of the detection and identifcation results of different networks.

Model	Classes	Precision	Recall
AlexNet			
	White spot	0.9474	0.9000
	Red leaf spot	1.0000	0.9130
	Healthy	0.8696	1.0000
	Gray blight	0.9583	1.0000
	Brown blight	1.0000	0.9500
	Bird's eyespot	1.0000	1.0000
	Anthracnose	1.0000	0.9655
	Algal leaf spot	0.9655	1.0000
GoogleNet			
	White spot	0.8148	0.7333
	Red leaf spot	1.0000	0.8235
	Healthy	0.7879	0.8667
	Gray blight	0.7500	0.8333
	Brown blight	0.8333	0.8333
	Bird's eyespot	1.0000	1.0000
	Anthracnose	0.9773	1.0000
	Algal leaf spot	0.7000	0.8140
OwnNetwork			
	White spot	1.0000	0.6000
	Red leaf spot	1.0000	1.0000
	Healthy	0.7692	1.0000
	Gray blight	1.0000	1.0000
	Brown blight	0.8182	0.9000
	Bird's eyespot	1.0000	1.0000
	Anthracnose	1.0000	1.0000
	Algal leaf spot	0.9833	1.0000

precision = TP / (TP + FP);recall = TP / (TP + FN);

X . Acknowledgment

It gives us great pleasure in presenting the preliminary project report on Detection of Diseases in Tea Leaves Using Convolution Neural Network '. Would like to take this opportunity to thank our guide Prof. A. V. Shinde. Sir for giving all the help and guidance We needed. We are really grateful to them for their kind support. Their valuable suggestions were very helpful.

We also grateful to Prof. S. D. Babar, Head of Computer Engineering Department, Sinhgad Institute of Technology, Lonavala for his indispensable support, suggestions. In the end our special thanks to other Person for providing various resources such as laboratory with all needed software platforms, continuous Internet connection, for Our Project.

XI. Conclusion

Generating and training of CNN model and gain accuracy. Our result shows that Trained model gives the accuracy using AlexNet and GoogleNet. In this Project 7 types of tea leaf disease images including one healthy leaf disease but in future we can increase the number of classes and modify the architecture accordingly to gain better accuracy.

XII . Future Scope

- Proposed system is efficient model than this existing architecture on real time data for mobile based IoT application.
- Future work will involve spreading the usage of the model by training it for plant diseases recognition on wider landareas.

References

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