2023 IEEE 3rd International Conference on Technology, Engineering, Management for Societal impact using Marketing, Entrepreneurship and Talent (TEMSMET) | 979-8-3503-9781-9/23/$31.00 ©2023 IEEE | DOI: 10.1109/TEMSMET56707.2023.10149957

MOBILE BASED APPLICATION FOR TEA LEAF DISEASE DETECTION.

Manasa J P
Department of ECE
VVIET, Mysuru
India.
manasajaiprakash@gmail.com

Nethravathi
Department of ECE
VVIET, Mysuru
India.
Nethragowdak1989@gmail.com

Abstract—Tea plant leaf diseases are one of the grand challenges that face in agriculture sector worldwide. In India approximately 20% to 30% of the leaves are lost due to various diseases each year. Tea leaf disease identification is challenging for limited-resources farmers if performed through optical observation of plant leaves symptoms. Therefore, it is important to catch the spread of the disease can spread of the disease in its early stage before they reach epidemic proportion 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 its early stage. it is practical to have an intelligent system for detection,identification and classification system in place as a preventive measure. This proposed model is a ML powered mobile based system to automate the plant leaf disease diagnosis process. The developed system uses CNN for feature reduction and classifying five diseases categories. The user interface is developed as a mobile application, allowing farmers to capture a photo of the infected Tea plant leaves. Captured image is then uploaded into the Database and then into the algorithm by specifying image path.It then displays the disease category and symptoms of disease along with the confidence percentage.This solutionwill be user friendly and will perform in an effective and efficient manner. It is expected that this system would create a better opportunity for farmers to keep their crops healthy and eliminate the use of wrong fertilizers that could stress the plants.

Key Words —Artificial Intelligence, Convolution Neural Network, Feature Extraction, Disease Recognition.

I. INTRODUCTION

In India, tea is one of the most popular libations. The majority of Indians begin their day with a cup of tea. The majority of the nation's tea is now produced in Assam. There are currently 174 commercial tea estates in the nation. The production of tea in India is severely affected by a number of pests and diseases that are brought on by a wide range of mites, nematodes, insects, bacteria, weeds, fungi, algae, and other diseases that are brought on by the local environment [3]. The majority of farmers in the agricultural sector use their own eyesight and prior knowledge to diagnose problems in tea leaves.

When local farmers have trouble identifying tea leaf illnesses, professionals are frequently needed to study the tea leaves. This process is not only time-consuming but also expensive. It is more crucial to catch the leaf disease early on before it spreads to epidemic levels among the plant; otherwise, the disease could spread much more quickly throughout the entire plantation, causing the farmers to suffer significant losses. It is practical to have an intelligent system of detection, identification, and classification system in place as a preventive step. This will help the farmers with the vital task of assisting them in recognizing the tea leaf diseases in their early stages.

II. SCOPE AND MOTIVATION

Farmers have a wide range of choices for field-based tea crop cultivation. However, these plantations are grown in a technological manner to provide the best harvest and highest quality of production. Therefore, by utilizing technologies such as image processing, the yield may be enhanced and the quality of the tea can be raised. Estimation of the agricultural crop the classification process is dynamic. The texture and color of the tea leaves are the most crucial visual characteristics. Therefore, categorization of tea leaf disease is essential for assessing agricultural products, raising the market value, and maintaining the required level of quality. This procedure will go on for too long. When using physical approaches for identification and classification, professionals are needed because the process can occasionally be error-prone and they are not always readily available. It is necessary to create a programme that uses leaf image processing methods to automatically identify and categories plant diseases [1]. Users may find this to be a valuable strategy that will warn them just in time to prevent the disease from spreading throughout a vast agricultural area. Therefore, employing a smart phone application instead of human aid to develop tea leaf disease detection will be much more beneficial. This solution will function effectively and efficiently while also being user-friendly.

III. IMPLEMENTATION

A standalone smartphone app built with React Native serves as the user interface for the Tea plant leaf disease detector. The business logic of the system was written in a single codebase using the React Native mobile native application development platform, which we then deployed as an iOS or Android application. The convolutional neural network (CNN) technique is locally executed by this react native application on the mobile device. In this smartphone application, a pre-trained Convolutional Neural Network (CNN) model is used. React Native will include a route that will handle the input image from the application and return the image's prominent features together with the disease name and suggest the solution to overcome the disease. Here Convolutional Neural Network (CNN) classifier has been used to detect tea leaf diseases because it has some advantages over other classifiers including:

1. Effective in high dimensional spaces.

2. It is also memory efficient because it only uses a portion of the training points in the decision function.
3. CNN model can easily integrated with the mobile application.

The mobile application allows farmers to capture the image of infected plants and allows to upload the image from the gallery in case of image is captured using digital cameras, is shown in figure 1.

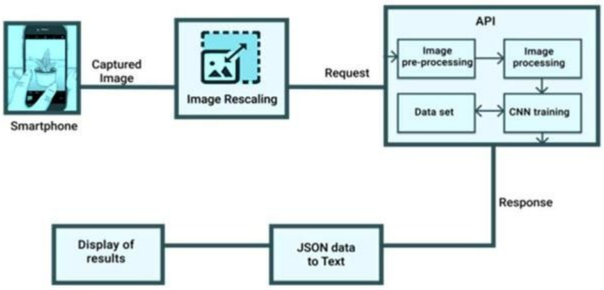

Fig:1 Block Diagram of the Proposed system

Then the captured image is rescaled to specified width, in this model the input image is rescaled to 1000 X 1000px. The rescaled image is then converted into tensor before image is passed to convolutionalneural network(CNN) model for prediction. Then this tensor is passed to the CNN model(API), which is embedded in the react native application and it accepts the image in the form of tensor and it returns the predicted results in the form of JSON(JavaScript Object Notation) data. This predicted result is then converted into plane text and this data is displayed on a screen. Here CNN model performs the following operation as shown in the figure 2.

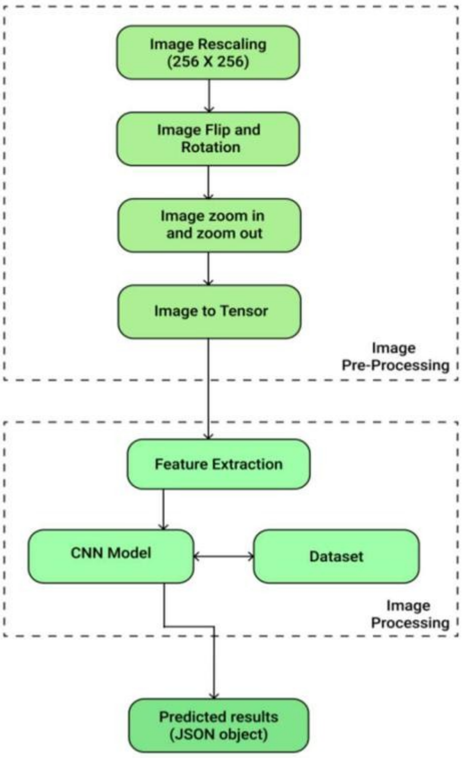

Fig:2 *Flow diagram of CNN model (API).*

3.1 Image pre-processing

To prepare image data for model input, image preprocessing is required. Convolutional neural networks (CNN) completely linked layers, for instance, demanded that all input images be in similar-sized arrays. Preprocessing a picture can speed up model inference and cut down on model training time [2]. Reducing the size of input photos will speed up model training time without affecting the CNN model's performance if the input images are very huge. The following pre-processing methods are taken into account in the proposed model.

1. **Rescale:** The majority of the time, input images may come in a variety of sizes, and some images may be smaller than the CNN's preferred square input image size. The photos must then be resized to the required width and height
2. **Random Flips:** The CNN model is forced to recognise that an item need not always be read from left to right or top to bottom by aimlessly rotating a picture about its x- or y-axis. Flipping is the best technique to enhance the performance of the model.
3. **Random Rotations:** Rotating the image is a useful alternative if an object has a range of potential exposures in relation to the acquired photographs.

3.2 Image processing with CNN

Using image pre-processing convolutional neural networks are used to extract the image's features (CNN).A neural network called CNN is created specifically to diagnose multi-dimensional data, such as picture and time series data. This procedure comprises weight computation during picture training and feature extraction from the image [6]. The primary benefit is the automatic feature extraction offered by CNN. As described in Figure 3, the requested input picture data is first sent to a CNN feature extraction network, and the retrieved features are subsequently sent to the classifier network.

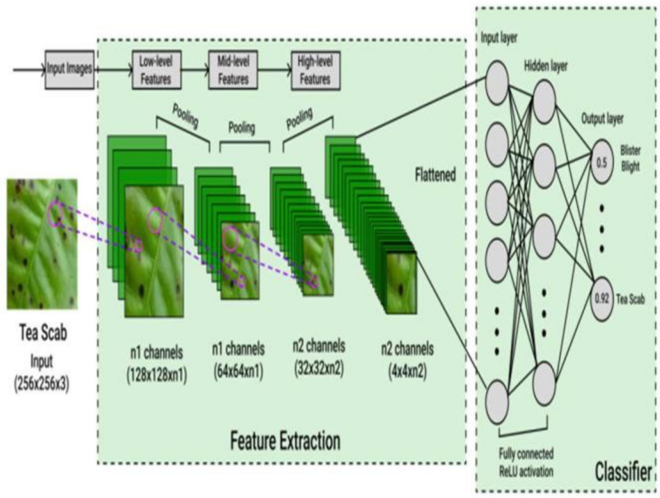

Fig: 3 *Simplified CNN architecture for disease classification.*

979-8-3503-9781-9/23/$31.00 ©2023 IEEE

There are numerous layer pairs of pooling and convolution in the feature extraction network. Convolutional layer is made up of a number of digital filters that perform convolution on the incoming image data. The threshold of the image is determined by the pooling layer, which is also utilized as the dimensional reduction layer. Thenumber of parameters that must be changed during backpropagation in CNN decreases, which inturn reduces the connections within the neural network architecture.

3.3 React Native application design

Following figures a, b, c, d are the different pages or screens that are developed in the TeaTech application for the extensive use for the users.

Fig:a*Splash Screen of an App* ***Fig:b****Home Screen of an App*

Fig:c *Camera screen of an app.* ***Fig:d*** *System Camera page to Capture image*

IV. RESULTS and ANALYSIS

The database developed for this work contains images of Tea leaves affected by the main diseases that affect tea crops. A total of 438 images of tea leaves were collected [5], including diseased leaves and healthy leaves these are affected by one or more types of pests and pathogens in different stages. The process of recognizing these tea leaf diseases using the CNN model is evaluated. The database is composed of the five most common types of diseases that affect this tea crop, which are Algal leaf spot, Blister blight, Tea leaf blight, Tea red leaf spot and Tea red scab. Also, database contains details of the healthy leaves.

Since object detection heavily depends on its context, many of the photos in this dataset are of objects in their natural settings. The training, testing, and validation sections of the dataset are separated. The number of tea leaf pictures utilized to train the CNN model is displayed in Table 1.

Table: 1 Dataset used for the training the CNN model.

Class	Disease type	Training	Validation	Testing	Total
1	Algal leaf spot	70	20	10	100
2	Blister blight	44	12	8	64
3	Tea leaf blight	31	9	5	45
4	Tea red leaf spot	44	12	8	64
5	Tea red scab	42	12	6	60
6	Healty leaf	73	21	11	105

This model is tested with various class, batch, and epoch settings in order to estimate the hyperparameters needed to increase performance and predictability. This model is specifically tested using arbitrary combinations of hyper parameter values until it produces results that are satisfactory. To reduce training loss and improve training accuracy, numerous picture preprocessing changes are used to the training dataset. The major goal of these modifications is to lessen the training process's reliance on background noise. This improved the model's stability and made it easier to learn about the six different disease types. Numerous photos are added for a few disease classes, such as Tea leaf blight and Tea red leaf spot that have an inadequate training dataset and a lot of background noise in order to address the over-fitting problem of the constructed CNN model. The spatial biases in the training data are avoided by using geometric transformation methods. Horizontal flipping, a 25° to 25° rotation, filling with immediate neighbours, a zoom with a range of 0.2, and width and height changes with an absolute scale of 0.3 were the geometric alterations executed to these classes [4]. In order to increase performance and forecast accuracy, this model is tested with various classes, batches, and Epochs. To test if this model can accurately predict results, several combinations of hyper-parameter values are used.

In terms of tea leaf disease classification accuracy, it has been found that this application performs well in most circumstances, even when plant leaf images are taken at distances between 10 and 25 cm from the camera, in different orientations, and with different lighting conditions. Many of the images in this dataset show things in their natural contexts because object detection significantly depends on context. The dataset is divided into training, testing, and validation portions. The samples of the correct identification of various plant leaf diseases are shown in Figure 5. Figures 5.1a through 5.1d show that the majority of the illness classes in the testing dataset are successfully classified by this disease detector application at a high rate.

979-8-3503-9781-9/23/$31.00 ©2023 IEEE

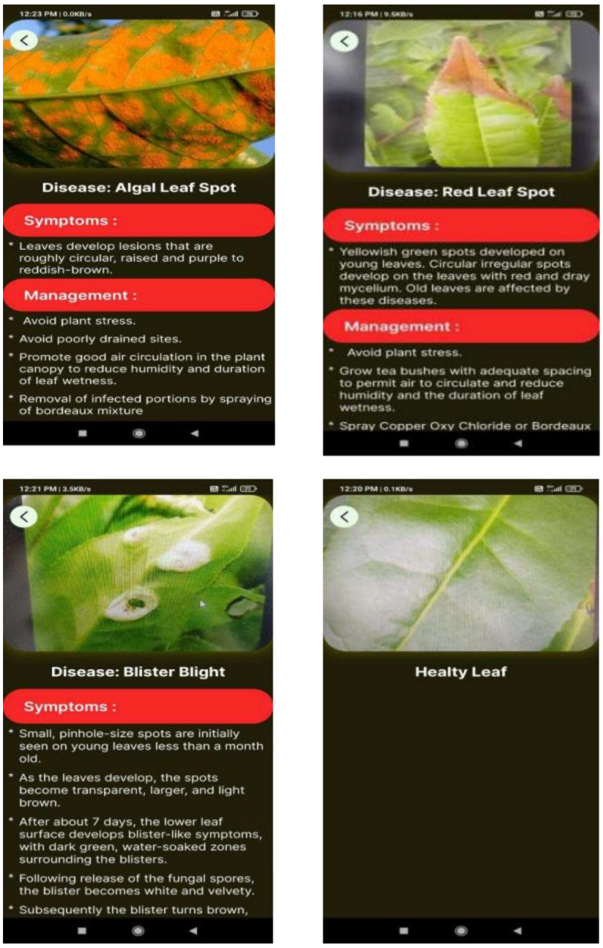

Fig:5 Examples of Tea Plant Leaf Diseases that have been Successfully Recognized Under Natural Conditions. (a) Red leaf spot, (b) Algal leaf spot, (c) Blister blight, (d) Tea red scab, (e) Tea leaf blight, (f) Healthy leaf .

Table 2: Average disease classification accuracy & prediction time of CNN model.

Class	Disease type	Accuracy	Prediction Time in sec
1	Algal leaf spot	99.3%	1.83
2	Blister blight	93.8%	1.23
3	Tea leaf blight	94.0%	1.76
4	Tea red leaf spot	95.2%	1.40
5	Tea red scab	98.9%	1.70
6	Healty leaf	100%	1.00

Table 2 shows that this model can distinguish between the various kinds of tea leaf diseases and reach high levels of prediction accuracy in the majority of situations. The model's accuracy is above 94 percent for blister blight, 99 percent for tea red scab, and 99 percent for algal leaf spot, three prevalent types of illnesses that affect tea crops. Also noted is that compared to bacterial and viral diseases (such blister blight and red scab), those produced by algae seem to be simpler to forecast. It would seem that prominent symptoms induced by fungal illnesses are easier to spot on plant leavesthan those with symptoms brought on by bacterial and viral infections.

V. CONCLUSION

The suggested Smartphone application for tea leaf image illness classification uses CNN to extract color and texture features in combination to identify the disease in tea leaves. The foundation for this is image processing, which examines the color characteristics of the regions in tea leaf portions. Using a limited training dataset, it was tested for tea leaf illnesses with an accuracy of over 92 percent. The classification, feature extraction, and quantification of the damaged tea leaf are all part of the methods used in this application to assess various tea leaf illnesses. This finding suggests that, in comparison to manual disease identification, the created mobile application can detect the diseases quite accurately. Convolutional neural networks (CNN) were used in the proposed approach, and it produced reliable results. The creation of this software gives farmers the best tool for utilizing their smart phones to diagnose pests and diseases in tea leaves.

The farmers first use their mobile device's camera to take photos of diseased tea leaf or choose an image from the gallery to send a digital image of a diseased tea leaf of a plant. These images are then interpreted in Python and automatically processed using CNN model, with the results being displayed on their mobile application. In the first step, photos of the healthy, normal, and sickly are gathered and pre-processed. The form, color, and texture characteristics of tea leaves are then retrieved from these photos. After that, these images are classified by Convolutional neural networks. The disease datasets are used to diagnose the appropriate features to find distinct features for identification of tea leaf disease. Based on the classified type of disease a text message was displayed on user's Smartphone.

VI. FUTURE SCOPE

Future potential in this field can be seen in three fascinating areas, including data collection and preparation, production environments, and expanded development.One of the most crucial elements is the calibre and quantity of the image dataset that increases the performance of a trained CNN model. The first stage in obtaining the necessary quantity of datasets is to gather the raw data, which will require significant processing time. The initial configuration of the tea leaf image data collection process would necessitate the development of instruments for automatic data acquisitiontools that would have to be employed based on the type of data required.

The CNN detection algorithm makes it simple to identify diseases on leaves. As a result, throughput is increased, and the subjectivity associated with agricultural specialists' tea leaf disease detection is diminished. A method for enhancing the quality of the image is to diagnose and manipulate it. This application enhances agricultural yield through the automatic symptom detection. Since it is advantageous, based on the early identification of tea leaf diseases, the farmers can receive the results in a short period of time and the best preventative actions.

REFERENCES

[1] R.S. Latha; G.R. Sreekanth; R.C. Suganthe; R. Rajadevi; S. Karthikeyan; S. Kanivel; B. Inbaraj ” Automatic Detection of Tea Leaf Diseases using Deep Convolution Neural Network” **ISBN:**978-1-7281-9299-4 issue. pp: 21 April 2021.

[2] Selim Hossain; Rokeya Mumtahana Mou; Mohammed Mahedi Hasan; Sajib Chakraborty; M. Abdur Razzak “Recognition and detection of tea leaf's diseases using support vector machine” **ISBN:**978-1-5386-0390-1 Issue pp.31 May 2018

[3] H. Panda , “The Complete Book on Cultivation and Manufacture of Tea” (2nd Revised Edition) Format: Paperback ISBN: 9788178331683 Code: NI242.

[4] ElhamOmrani,BenyaminKhoshnevisan, ShahaboddinShamshirband, HadiSaboohi, Nor BadrulAnuar, MohdHairul Nizam Md Nasir, “Potential of radial basis function-based support vector regression for apple disease detection”, Measurement, Vol.55, pp.512–519, Sept-2014, (Elsevier).

[5] Dheeb Al Bashish, Malik Braik, and Sulieman Bani-Ahmad, “A Framework for Detection and Classification of Plant leaf and Stem Diseases”, 2012 International conference on Signal and Image Processing, Chennai, India, pp.113-118.

[6] P. Revathi, M. Hemalatha, “Cotton Leaf Spot Diseases Detection Utilizing Feature Selection with Skew Divergence Method”, International Journal of Scientific Engineering and Technology (ISSN : 2277-1581), Vol.3, Issue 1, pp. 22-30, Jan 2014.

[7] S. Gayathri; D.C.Joy Winnie Wise; P. Baby Shamini; N. Muthukumaran “Image Analysis and Detection of Tea Leaf Disease using Deep Learning” **ISBN:**978-1-7281-4109-1 issue. pp: 04 August 2020

979-8-3503-9781-9/23/$31.00 ©2023 IEEE