Journal of Cardiovascular Disease Research,
Volume 12 (4), ISSN: 0975-3583, 0976-2833

ORIGINAL ARTICLE

ML Based Disease Identification and Grain Classification of Rice

Gadu SrinivasaRao [#1], Gadi Himaja [#2], Veera Nitish Mattaparthi [#3], A.Masimo Monish [#4], Nithin Kamineni [#5], Pachamatla Vamsi [#6], V. Saieswar Reddy [#7]

[#1, 2] Assistant Professor, Department of Computer Science and Engineering,
Gitam Institute of Technology, Visakhapatnam-530045.

[#3, 4, 5, 6,7] Students, Department of Computer Science and Engineering.

Received: 15 March 2021; Accepted: 20 May 2021; Published: 20 July 2021

Abstract

In general agriculture is one of the main sources of income for the farmers and Indian economy greatly depends on agriculture growth and development for better production. Almost three fourths of the world require rice production for their survival and this is cultivated almost all over the world, mostly in Asian countries. However, the farmers have been facing with some continuous challenges for centuries, such as different diseases of rice. If those diseases are not identified in the early stages, there will be a huge loss for the farmers as well as human beings who wish to consume that product. If the plant disease is identified in the early stages, it will be very helpful for the agriculture specialist or farmers to boost up the crop by taking necessary preventive steps and try to increase the profit. Normally the plant experts or specialist try to find out the plant or leaf illnesses based on external symptoms examination, but sometimes this may not give accurate reports. As we all know that the structure of rice plant diseases and insects is very minute and hence it is complex task to predict the diseases and different species in the plants and try to take necessary steps by spreading the pesticides or insecticides for the plants.In order to overcome all these problems, we try to design an application which can able to identify the plant disease from the affected part of crop image and then find out remedies for that disease. At present, it is very interesting to design the deep intricate neural network (CNN) is the latest image recognition solution. Here we try to gather several infected rice plant images and apply ML Algorithm and CNN model to identify the disease name and also find out the necessary preventive measures for that plant. Nevertheless, manual detection of disease costs a large amount of time and labor, so it is inevitably prudent to have an automated system to detect disease. To solve the above problem, we are developing a Machine Learning model using a CNN algorithm to detect the rice crop disease using the image and provide a suitable remedy. By conducting various experiments on our proposed model, we achieved a classification accuracy of 97.17% and 99.45% when applied to the test dataset. These remedies give information on pesticide use to control the disease. As an extension for the current application we try to try to find out the characteristics of rice grain and try to classify the grain name based on shape, size and color. Finally we try to conclude that proposed dataset was trained with a range of different machine learning algorithms and achieved an accuracy of 91.30% on Decision Tree Classifier.

Keywords:

Machine Learning Algorithms, Deep Neural Networks, Decision Tree Classifier, Agriculture Growth, Image Recognition.

Journal of Cardiovascular Disease Research,
Volume 12 (4), ISSN: 0975-3583, 0976-2833

1. Introduction

As we all know that most of the people in the world consume rice as a primary food. The production and quality of rice will be dependent on a number of factors to improve the production. In general for good production of plants we try to use several pesticides during the lifetime of the rice plant and this may cause some diseases. Hence it became a major challenge for the farmers to diagnose and detect the rice plant disease and find out the natural ways for diagnosis of rice plant diseases in the agriculture field. Normally, diagnosis of plant disease in a natural way requires a very lot of information and there should be very keen knowledge on all parts of plants. Hence the normal way to detect and diagnose plant diseases takes a lot of effort for the individuals, hence nowadays all are using machine learning models[2] to predict and trace the several types of diseases in the agricultural domain.

In general there are several types of rice plant diseases in the real world environment and each and every disease is having some similar and some dis-similar qualities behind the classification. In general by observing the images directly one cannot differentiate the diseases very easily because some diseases [1] are very microscopic and require very keen observation. Hence the structure of the rice plant affected part is first captured and the structure of that infected portion is verified thoroughly to classify the disease type. In general we can see 6 common diseases which are found in rice plant they are as follows:

1) Leaf Blast(LB)
2) Brown Spot(BS)
3) Sheath Blight(SB)
4) Leaf Scald(LS)
5) Bacterial Leaf Blight(BLB)
6) Rice Blast (RB)
7) Sheath Rot (SR)

Now we can see the detailed explanation about each and every disease and we can see all these 6 types of diseases in below figures.

1. Leaf Blast (LB):

This is one of the most important problems which are affecting rice plants and this can be identified clearly by the external appearance. If the rice plant is having any black dots in oval shape, dots with different colors range from reddish brown color to gray white points, then we can identify and classify that disease as leaf blast.

Figure 1. Represent the Leaf Blast Disease in Rice Plant

Journal of Cardiovascular Disease Research,
Volume 12 (4), ISSN: 0975-3583, 0976-2833

2. Brown Spot (BS):

This is also clearly seen and identified by the external appearance which is visible on the leaves. If the plant is having any indications with dark brown lesions with either round or oval shape, then we can say it is affected with brown spot disease.

Figure 2. Represent the Brown Spot Disease in Rice Plant

3. Sheath Blight (SB):

This is one kind of infection which will be affecting both leaves and stems of the rice plant. This will be appeared either in white or straw colored show in center with reddish brown spots and this is almost oval shape.

Figure 3. Represent the Sheath Blight Disease in Rice Plant

4. Leaf Scald (LS):

This is one kind of disease which will be appeared mainly on the leaf part and this is always visible on edge of the leaf. This will be appeared either on yellow or gold color. Sometimes this will be appeared in the lesion of the rice plant where the edge of the leaf is appeared with yellow color.

Figure 4. Represent the Leaf Scald Disease in Rice Plant

Journal of Cardiovascular Disease Research,
Volume 12 (4), ISSN: 0975-3583, 0976-2833

5. Bacterial Leaf Blight (BLB):

This is some sort of bacteria which is present in lesions of the rice plant and this bacterium will be always present at the tip of the leaf. This will be affected around several centimeters long, and this will be having color from white and sometimes yellow and color changes gradually with the bacteria level.

Figure 5. Represent the Bacterial Leaf Blight Disease in Rice Plant

6. Rice Blast (RB):

This is one kind of disease which is caused from the fungus family of Magnaporthe Oryza. This will be having indication in white color to gray-green lesions or blemishes and if there is very less affect, it will be in dark green border. If there is more fungus on the plant orrice, then we can see more and more lesions on the leaves are oval or spindle-shaped with anecrotic edge.

Figure 6. Represent the Rice Blast Disease in Rice Plant

7.Sheath Rot (SR):

This is one kind of rice plant disease which comes under fungal category, this was formed from two fungal species namely sarocladium oryza and sacroladium tensum. This will be initially seen in root begins with upper sheath of the spikelet. This will be appeared like an asymmetrical stain with almost dark red or gray spots present in the midpoint.

Figure 7. Represent the Sheath Rot Disease in Rice Plant

Journal of Cardiovascular Disease Research,
Volume 12 (4), ISSN: 0975-3583, 0976-2833

Normally image filters are expected to be automated feature learning for extracting the important features which are present in the rice plant. Initially we try to take rice plant images and then check the several features which are present on that image and check each and every image for predicting the outcome. Now a days all the features are automatically extracted by using ML tools. These tools are really helpful for the farmers to identify several diseases which are present on the plant and then try to classify the rice disease based on images.

2. LITERATURE SURVEY

Literature survey is that the most vital step in the software development process. Before developing the new application or model, it's necessary to work out the time factor, economy, and company strength. Once all these factors are confirmed and got approval then we can start building the application. The literature survey is one that mainly deals with all the previous work which is done by several users and what are the advantages and limitations of those previous models. This literature survey is mainly used for identifying the list of resources to construct this proposed application.

MOTIVATION

1) Prediction of Rice Diseases Using Convolutional Neural Network, Published In International Journal of Innovative Science and Research Technology at Volume 4, Issue 12, December – 2019.

AUTHORS: A. Sony

In this paper, the authors mainly concentrated on the diagnosis of rice plant diseases and remedies[3]. In general detection of rice pest and diseases plays a prominent role for the control of infected plant and improves in growth. The authors also discussed that using the modern technologies like smart phones, farmers can able to detect and identify the pest present in the rice crop. In this paper the authors used Convolutional Neural Network using r language to predict the diseases which are present in rice plant by gathering images of disease leaves. In order to train the system the authors collected the infected rice plant images from UCI Machine Learning Repository which contains 3 types of diseases like Bacterial Leaf Blight, Brown Spot, Leaf Smut.

2) Deep learning approach for recognition and classification of yield affecting paddy crop stresses using field images,Published In Artificial Intelligence in Agriculture Volume 4, 2020, Pages 12-20.

AUTHORS: Basavaraj S.Anami and SurendraPalaiah

In this paper the author try to discuss about the deep convolutional neural network (DCNN) framework for automatic recognition and classification paddy crop diseases[4].This work is mainly motivated by the pre-trained model like VGG 16 CNN model which is used for automatic classification.In general if we use the VGG 16 model for identifying the disease it will generate the result with accuracy of 92.89% and this will be applied on 30,000 field images of 5 different paddy crop varieties with 12 different stress categories.

3) Rice Disease Detection Using Deep Learning, published in International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-7, Issue-5S3, February 2019.

AUTHORS: V.Vanitha

In this paper, the authors mainly discussed the rice bacterial leaf blight disease. In general the authors discussed that early detection can help to limit the spread of diseases[5] and ensure the quality of crop. In this article the authors mainly described that if the automatic detection of rice plant diseases are introduced we can able to save lot of effort in order to identify the disease and can able to increase the farming. In general the authors try to gather a dataset of more than five hundred images of healthy and diseased samples and then it was used to train the system for finding the diseases present on the paddy crop. The experimental results show that we can effectively detect and recognize three classes of rice diseases best accuracy of 99.53% on test set.

3. EXISTING SYSTEM AND ITS LIMITATIONS

In the existing system, there was no proper method to identify the several types of fungal or diseases present in the rice plant. Almost all the farmers or agriculture specialist try to find out the disease using manual approach by examining the external appearance of that rice crop and try to provide necessary remedy for that. In some cases the manual method is unable to trace or figure out the internal abnormalities automatically and find out the remedies for that disease. The following are the main limitations of the existing system.

LIMITATIONS OF THE EXISTING SYSTEM

1) Time Complexity
2) There is no automatic approach for rice plant disease or abnormality detection.
3) All the abnormalities are found in a manual way which is very complex for normal users.
4) There is no automatic approach for identifying the physical parameters.
5) There is no automatic approach to identify the rice grains and its physical characteristics based on its color, size and shape.

4. PROPOSED SYSTEM AND ITS ADVANTAGES

The proposed application is designed using machine learning and deep learning models in the medical field for disease prediction and to guide the agriculture experts about the rice plant growth and improve the economic status of the country. In this present work, we try to identify the most important physical parameters which are required to identify the rice plant diseases and also collected several sample images which contains both healthy and infected plant images. Here we propose a novel method to predict and trace the several diseases which are present in rice plant and find out the remedies for that disease.

Journal of Cardiovascular Disease Research,
Volume 12 (4), ISSN: 0975-3583, 0976-2833

ADVANTAGES OF THE PROPOSED SYSTEM

1) By using the proposed deep learning model prediction of abnormalities in the rice plant is very easy.

2) It generates a very accurate result

3) It is less time complexity

4) This reduces a lot of effort for the agriculture specialist or farmers to find out the abnormalities.

5) This is very efficient in finding the several diseases present inside the rice plant in very accurate manner.

6) This proposed method is very accurate in tracing all the internal abnormalities which are present in rice plant which cannot be seen directly with our human eye contact.

7) The proposed method is very accurate in identifying the rice grain type and its characteristics.

5. PROPOSED RICE DISEASE DETECTION AND RICE GRAIN CLASSIFICATION

In this section we try to discuss about two methods which are proposed like:

a) Rice Disease Prediction

b) Rice Grain Classification[6]

a) Rice Disease Prediction

In this system for detecting the Rice Brown spot, Leaf Blast and Rice Hispa disease of paddy, we try to divide the whole process into two phases:

1) Training Phase in which the dataset is trained by gathering several samples collected from machine learning repositories.

2) The second phase is Detecting the disease from given sample images.

In the starting phase we try to deal with some sample dataset which contains nearly 523 images of Rice Brownspot, 779 images of Leaf Blast, 565 images of Hispa and 1448 healthy paddy leaf images[7]-[10]. These images are trained with the help of Convolutional Neural Network (CNN) Algorithm. By using this proposed method we can able to detect the diseases which are present in the paddy crop and also we can provide the most suitable remedies for that plant. All these disease prediction and remedies are mainly generated by the current CNN model.

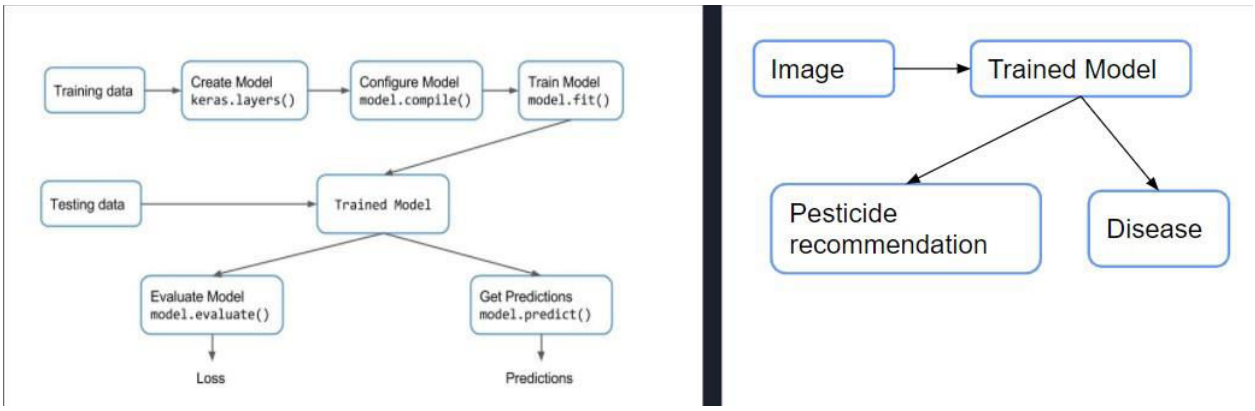


Figure. 8. Represents the Proposed Model for Rice Disease Prediction

From the above figure 8, we can clearly identify the rice plant disease prediction using sample images collected and then check if the image is containing the disease or virus and then check if there are any pesticide recommendation or not.In the testing phase the same data preprocessing is done and the image data is uploaded to CNN algorithm then the given image vector is compared with the training model vector then the model is able to detect the disease andprovides the remedies.

b) Rice Grain Classification

At this stage we try to classify the rice grain and find out which category it come under based on the physical characteristics.In general for classification of rice grains[11] we need to collect the dataset which contains all the features to easily classify the rice plant.The main features which are used for rice classification is length,width,l/w ratio,shape,color. In order to classify several rice varieties we try to train the system with some rice varieties such as BPT, Basmati, Sonnamasuri, NLR,Nawara Rice,Brown Rice. All these several rice types are classified and trained into the system model and now if the user enter any rice image as input for the model,we can able to identify the rice characteristics and then find out which category this rice sample belong to. For this classification we try to use several ML algorithms such as Logistic Regression, Decision Trees, etc. Each and every algorithm gives different parameters which are required for the classification[12].

Rice grains are mainly classified concerning their texture, color, grain shape, etc.. The trained model identifies the different rice varieties and gives information about the nutrients available and their advantages.

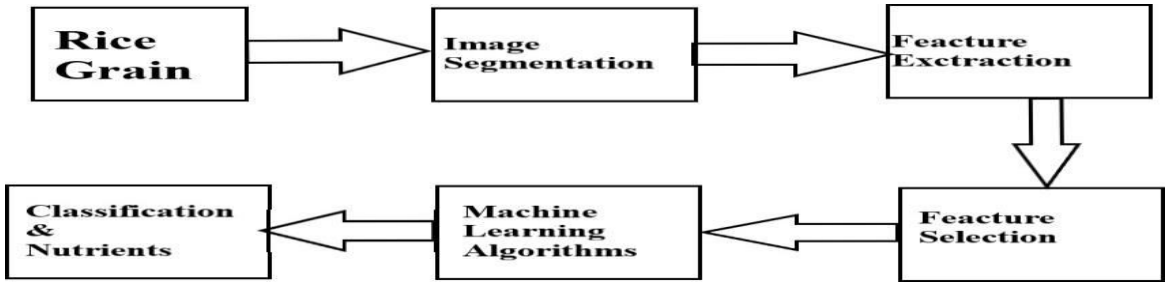


Figure. 9. Represents the Proposed Model for Rice Grain Classification

6. CNN ARCHITECTURE FOR RICE DISEASE PREDICTION MODEL

In this section we try to examine the rice grain disease prediction model based on CNN Architecture. In this section we try to find out the diseases which affect the rice or paddy plants and involve the detailed case study of problem detection from the rice or paddy images. In general the rice disease prediction involves two phases for disease prediction, in the first phase we try to load the model using the image dataset. This dataset contains both infected and healthy plant leaf images, in general we collected all these input dataset from KAGGLE website. The second phase of this current application is try to apply Convolutional Neural Network (CNN) algorithm on the input data.

CNN ARCHITECTURE

A CNN model mainly contains of following layers such as

1. Input Layer
2. Multiple Hidden Layers
3. Output Layer

In the starting stage we will try to load all paddy crop related images as input for training the model, those image loading is considered as first stage in the CNN.Now we try to apply some internal filters to classify the input dataset as per the user requirement, those all are contained in hidden layer. The following are some of the hidden layers filters such as Convolution layer, Rectified Linear Unit, pooling layer and fully connected layer. The output layer is one which can predict the output based on the user requirement.

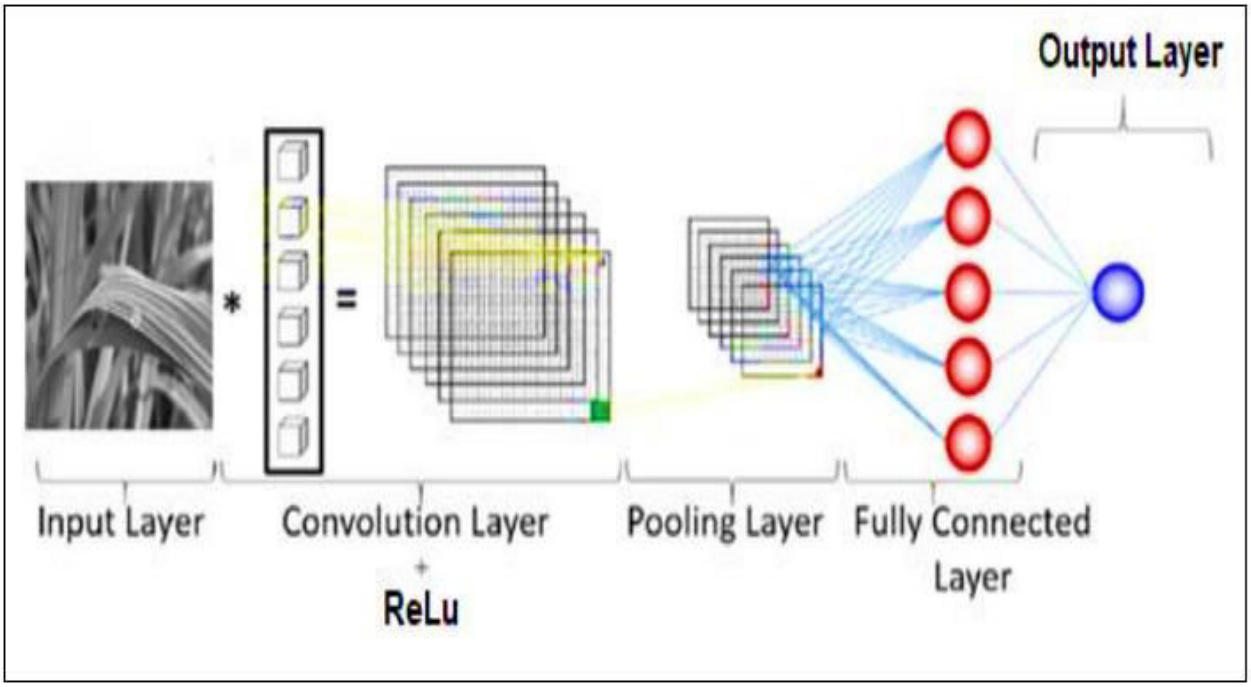


Figure. 10. Represents the Proposed CNN Model

Now from the above figure 10, we can clearly identify the flow of our proposed CNN model. Now let us look into this model in detail:

CONVOLUTIONAL LAYER

In this layer we try to load all the input images which are collected from KAGGLE website for training the model. Here our proposed model will try to perform the convolution operations on the input samples and then try to apply Kernel filters on that inputs. This layer is mainly used to perform the filter level applications on feature map of previous layers and this will be continued until last later and finally they produce the feature maps from the input data.

RECTIFIED LINEAR UNIT (RELU)

In this layer once the feature maps are extracted in Convolutional layer, now they are used for activation.This activation layer is known as ReLu layer which uses some activation function. In general there are several activation function layers such as sigmoid,Tanh,ReLU,Softmax and so on.In this current model we try to use ReLU activation function as hidden layer, which is one of the most widely used activation function.In ReLu layer those who are having negative pixels from input image as replaced with pixel value '0' and remaining all pixels are kept as it is normal. The ReLU function can be used as follows:

$$f(x) = \begin{cases} 0 & \text{if } x<0 \\ x & \text{if } x>=0 \end{cases}$$

where x is a pixel value

3. POOLING LAYER

In this layer once image features are extracted and negative pixels are classified, now we need to perform some internal operations for reducing the image dimensions such as (Width, Height), resulting dimensionality reduction. The goal of this pooling layer in CNN model is to reduce the ir-regular size of images into normal image and then compress the image into lesser size. The two main layers which are used for reduction of size are average pooling and Max pooling. In max pooling layer those who has highest pixel value is taken as final parameter and in average pooling takes the average of all pixel values within the window.

4. FULLY CONNECTED LAYER

Once after performing all the above layers we try to apply this fully connected layer in order to reduce the image size into very lesser size ,so that image is reduced to a vector. This is the main layer which is applied for logic classification and this will produce a lot of N-dimensional vector, where every neuron in this layer contains the vectors of the features extracted from the image. The current system is mainly used for detecting the paddy diseases

and provides the suitable remedies, thus leads to increase in paddy crop production.

7. EXPERIMENTAL RESULTS

Implementation is a stage where the theoretical design is converted into a programmatic manner. In this proposed application we try to use PYTHON as a programming language in which Google Collaboratory or Jupiter Notebook as a working platform to process the current application.

STEP 1: IMPORTING ALL NECCESARY LIBRARIES

```
# Import Libraries
import os
import glob
import matplotlib.pyplot as plt
import numpy as np
import tensorflow as tf
# Keras API
import keras
from keras.models import Sequential
from keras.layers import Dense,Dropout,Flatten
from keras.layers import Conv2D,MaxPooling2D,Activation,AveragePooling2D,BatchNormalization
from keras.preprocessing.image import ImageDataGenerator

tf.compat.v1.logging.set_verbosity(tf.compat.v1.logging.ERROR)
```

STEP 2: Load train and test data into separate variables

```
# Loading train and test data into seperate variables
train_dir ="C:\\Users\\balas\\Desktop\\rice_disease\\LabelledRice\\Labelled"
test_dir="C:\\Users\\balas\\Desktop\\rice_disease\\RiceDiseaseDataset\\validation"
```

STEP 3 : Pre-processing our raw data into usable format.

```
# Pre-processing images with ImageDataGenerator function parameters
train_datagen=ImageDataGenerator(rescale=1./255,        #transform every pixel value from range [0,255] -> [0,1]
                                 shear_range=0.2,       #randomly applying shearing transformations
                                 zoom_range=0.2,        #randomly zooming inside pictures
                                 horizontal_flip=True)#randomly flipping half of the images horizontally
test_datagen=ImageDataGenerator(rescale=1./255)         #whatever preprocessing done to test images same is done to test images
```

```
#Generating augmented data from train and test directories
img_width,img_height =256,256        #set height and width and color of input image
input_shape=(img_width,img_height,3)
batch_size =32                       #refers to the number of training examples utilized in one iteration
train_generator =train_datagen.flow_from_directory(train_dir, #Takes the path to directory,and generates batches of augmented data
                                                   target_size=(img_width,img_height),
                                                   batch_size=batch_size)
test_generator=test_datagen.flow_from_directory(test_dir,
                                                shuffle=True,
                                                target_size=(img_width,img_height),
                                                batch_size=batch_size)
```

```
Found 492 images belonging to 4 classes.
```

- Resizing image values between (0 –1) called normalization.
- Whatever pre-processing you do with the train it should be done to test parallelly.
- All these parameters are stored in the variable “train_datagen and test_datagen”.

And then generate augmented data from train and test directories.

STEP 4: Building CNN Model

```
# CNN Model building
model = Sequential()
model.add(Conv2D(32, (5, 5),input_shape=input_shape,activation='relu'))
model.add(MaxPooling2D(pool_size=(3, 3)))
model.add(Conv2D(32, (3, 3),activation='relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Conv2D(64, (3, 3),activation='relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Flatten())
model.add(Dense(512,activation='relu'))
model.add(Dropout(0.25))
model.add(Dense(128,activation='relu'))
model.add(Dense(num_classes,activation='softmax'))
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 252, 252, 32)      2432
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 84, 84, 32)        0
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 82, 82, 32)        9248
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 41, 41, 32)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 39, 39, 64)        18496
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 19, 19, 64)        0
_________________________________________________________________
flatten (Flatten)            (None, 23104)             0
_________________________________________________________________
dense (Dense)                (None, 512)               11829760
_________________________________________________________________
dropout (Dropout)            (None, 512)               0
_________________________________________________________________
dense_1 (Dense)              (None, 128)               65664
_________________________________________________________________
dense_2 (Dense)              (None, 4)                 516
```

CNN shrinks the parameters and learns features and stores valuable information outputshape is decreasing after every layer.

STEP 5 : Start Training CNN with Parameters and fit the model.

- Adam optimizer is used with learning rate=0.001
- Loss function categorical_crossentropy is used for our Multi-class classificationproblem. Metrics is “ accuracy”.
- Fit_generator is used to train the CNN model. Using the validation data parameterfor fine-tuning the model.

```
#Start training CNN with parameters
#Generating validation augmented data from train directories
validation_generator = test_datagen.flow_from_directory(
                       test_dir, # same directory as training data
                       target_size=(img_height, img_width),
                       batch_size=batch_size)
opt=keras.optimizers.Adam(lr=0.001)
model.compile(optimizer=opt,loss='categorical_crossentropy',metrics=['accuracy'])
```

```
train=model.fit(train_generator,steps_per_epoch=15, epochs=50, verbose=1, callbacks=None,
    validation_data=validation_generator, validation_steps=None, validation_freq=1,
    class_weight=None, max_queue_size=10, workers=1, use_multiprocessing=False,
    shuffle=True, initial_epoch=0
)
```

```
Epoch 1/50
15/15 [==============================] - 81s 5s/step - loss: 0.3557 - accuracy: 0.8739 - val_loss: 0.3315 - val_accuracy: 0.8720
Epoch 2/50
15/15 [==============================] - 79s 5s/step - loss: 0.3767 - accuracy: 0.8761 - val_loss: 0.3249 - val_accuracy: 0.8699
Epoch 3/50
15/15 [==============================] - 79s 5s/step - loss: 0.3497 - accuracy: 0.8630 - val_loss: 0.2694 - val_accuracy: 0.8963
Epoch 4/50
15/15 [==============================] - 79s 5s/step - loss: 0.3845 - accuracy: 0.8435 - val_loss: 0.7160 - val_accuracy: 0.7337
Epoch 5/50
15/15 [==============================] - 78s 5s/step - loss: 0.4111 - accuracy: 0.8478 - val_loss: 0.3379 - val_accuracy: 0.8801
Epoch 6/50
15/15 [==============================] - 79s 5s/step - loss: 0.3763 - accuracy: 0.8543 - val_loss: 0.4005 - val_accuracy: 0.8679
Epoch 7/50
15/15 [==============================] - 78s 5s/step - loss: 0.3694 - accuracy: 0.8783 - val_loss: 0.3090 - val_accuracy: 0.9004
Epoch 8/50
15/15 [==============================] - 77s 5s/step - loss: 0.2732 - accuracy: 0.9043 - val_loss: 0.2647 - val_accuracy: 0.9126
Epoch 9/50
15/15 [==============================] - 79s 5s/step - loss: 0.2794 - accuracy: 0.8761 - val_loss: 0.2224 - val_accuracy: 0.9207
Epoch 10/50
15/15 [==============================] - 78s 5s/step - loss: 0.2810 - accuracy: 0.9043 - val_loss: 0.2504 - val_accuracy: 0.9248
Epoch 11/50
15/15 [==============================] - 81s 5s/step - loss: 0.2354 - accuracy: 0.8935 - val_loss: 0.2342 - val_accuracy: 0.9167
Epoch 12/50
15/15 [==============================] - 79s 5s/step - loss: 0.3411 - accuracy: 0.8870 - val_loss: 0.2516 - val_accuracy: 0.9106
Epoch 13/50
```

After training the model we got classification accuracy of 97.17 %

```
print(max(train.history['accuracy']))
```

```
0.9717391133308411
```

STEP 6 : Saving Model weights

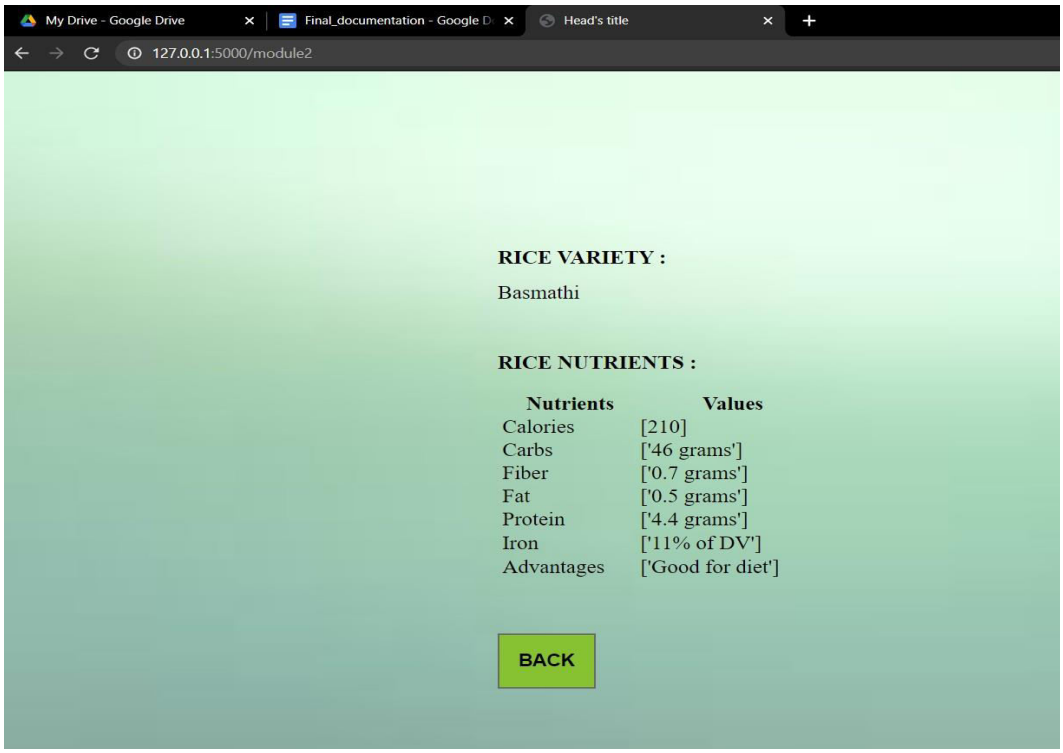
```
# Save model
from keras.models import load_model
model.save('crop.h5')
```

```
from keras.models import load_model
model=load_model('crop.h5')
# Mention name of the disease into list.
Classes = ['BrownSpot', 'Healthy', 'Hispa', 'LeafBlast']
```

STEP 7 : Predictions

- we need to preprocess our image to pass in a model to predict
- First, we resize the image ===> image(256,256)
- convert image to array by this it will add channels===>image(256,256,3)
- Tensorflow works with batches of images. We need to specify image samples===>(1,150,150,3).
- Predict_classes help to predict the new image belongs to the respective class.

NEXT WE TRY TO SEE IMPLEMENTATION OF RICE CLASSIFICATION



8. CONCLUSION

In this current work we for the first time designed and implemented an application using machine learning (ML) models in the agriculture field for rice disease prediction and to guide the farmers or agriculture experts about the rice plant disease. we try to design an application which can able to identify the plant disease from the affected part of crop image and then find out remedies for that disease. At present, it is very interesting to design the deep intricate neural network (CNN) is the latest image recognition solution. Here we try to gather several infected rice plant images and apply ML Algorithm and CNN model to identify the disease name and also find out the necessary preventive measures for that plant. To solve the above problem, we developed a Machine Learning model using a CNN algorithm to detect the rice crop disease using the image and provide a suitable remedy. By conducting various experiments on our proposed model, we achieved a classification accuracy of 97.17% and 99.45% when applied to the test dataset. These remedies give information on pesticide use to control the disease. As an extension for the current application we try to try to find out the characteristics of rice grain and try to classify the grain name based on shape, size and color. Finally we conclude that proposed dataset was trained with a range of different machine learning algorithms and achieved an accuracy of 91.30% on Decision Tree Classifier.

9. REFERENCES

1) Gupta, T., 2017, 'Plant leaf disease analysis using image processing technique with modified SVM-CS classifier', Int. J. Eng. Manag. Technol, 5, pp.11-17.
2) Arivazhagan, S. and Ligi, S.V., 2018. Mango Leaf Diseases Identification Using Convolutional Neural Network. International Journal of Pure and Applied Mathematics, 120(6), pp.11067-11079
3) Prediction of Rice Diseases Using Convolutional Neural Network, Published In International Journal of Innovative Science and Research Technology at Volume 4, Issue 12, December – 2019.
4) Deep learning approach for recognition and classification of yield affecting paddy crop stresses using field images,Published In Artificial Intelligence in Agriculture Volume 4, 2020, Pages 12-20.
5) Rice Disease Detection Using Deep Learning, published in International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-7, Issue-5S3, February 2019.
6) M. Martineau, D. Conte, R. Raveaux, I. Arnault, D. Munier, et al, "A survey on image-based insect classification", Pattern Recognition, Elsevier, vol. 65, pp.273 – 284, 2017.
7) S. D. Khirade and A. B. Patil, "Plant Disease Detection Using Image Processing", in International Conference on Computing Communication Control and Automation (ICCUBEA), IEEE, Pune, India, 2015, pp. 768- 771.
8) Suman T. and Dhruvakumar T., "Classification of paddy leaf diseases using shape and color features", International Journal of Electrical and Electronics Engineers (IJEEE) vol. 07, Issue 01, pp. 239–250, Jan-June 2015.
9) P. L. Sahu, A. Singh and K. L. Sinha, "A Survey on Data Mining Techniques for Classification of Images", in International Conference on Mechanical, Electronics and

Computer Engineering (ICMECE-2014), Raipur, India, vol. 2, Issue 1, pp. 65-70, 2015.

10) Rice Grains Classification Using Image Processing Technics Herath H.M.K.K.M.B and Eng.de Mel W.R Department of Mechanical Engineering,The open university of Sri Lanka, PP.1-6, 2016.
11) An Efficient Method For Quality Analysis Of Rice Using Machine Vision System, Rahul Birla, Ajay Pal Singh Chauhan, Electronics and communication engineering Department, Journal of advances in Information technology,Volume 6,No.3, PP.140-145, 2015.

12) Identification Of Food Grains And Its Quality Using Pattern Classification, Sanjivani Shantaiya, Mrs.Uzma Ansari, Special Issue of IJCCT 2010 for International Conference[ICCT-2010], Volume 2,Issue 2,3,4;pp.70-74, 2010.