Plant Disease Detection for Agriculture Using Machine Learning

Kalaivani R[1], Padmavathi[2]

[1]Professor, Department of Electrical and Electronics Engineering, Rajalakshmi Engineering College, Chennai,
[1]Assistant Professor, Department of Electrical and Electronics Engineering, Rajalakshmi Engineering College, Chennai, India
[1]kalaivani.r@rajalakshmi.edu.in

Abstract: *Plants get exposed to various attacks by microorganisms, disease caused by bacteria and insects. The warnings of the attacks are clearly distinguished through the leaves, stem and fruit inspection, where either one of these are affected. In Recent Years, Deep Learning has led to great performance in various fields like Image Recognition, Speech Recognition, and Natural Language Processing. The use of the Convolution Neural Network in the Problem of Plant Disease Detection has very good results. Early Disease Detection is important for better yield and quality of crops. With Reduction in Quality of the Agricultural Product, Diseased Plant can lead to the huge Economic Losses to the Individual farmers. In this paper we have proposed a Machine learning-based approach for image recognition. Convolution Neural Network comes under the sub domain of Machine Learning. It involves the extraction of features from the image to observe some patterns in the dataset. The model uses RFID module to switch on or off the camera. The RFID module is used to protect the camera from capturing unwanted images which can be used later. The output of the sample leaves images will be displayed in the LCD display. Hardware implementation of this project has been done and the results are compared with simulation results. The simulation is carried out in Tensor Flow to obtain the system performance.*

Key words: *Machine Learning, CNN, RFID, LCD, Camera.*

1. Introduction

India is a cultivated country and about 70% of the population depends on agriculture. Monitoring of health and disease on plants plays an important role in successful cultivation of crops in the farm. The image of the affected leaf is given as input to the ML Model which is created by training and testing over several datasets. Convolution Neural Network (CNN) is used to process pixel data to the Machine Learning model.

As the topology discussed [1] consists of a hand-held multispectral radiometer to detect and measure the intensity of plant disease gradients in Peanut. Then Digital Image processing has been utilised to extract the signs of infection from the leaves of the plants [2] the emergent calculates the affected region and it is indicated based on the percentage of disease detection. The technical algorithms like K-means clustering and support vector machines have been used for comparing and percentage of disease detection. The analysis of the work has been processed by considering the objective values which are the mean, Entropy, and variance.

Changes in temperatures and changes in the shade of plant are a typical indication of plant disease [3] and they are sensed through sensors. The pigments in leaves oversee the striking shading in the plants. Temperature, light during the day, and soil dampness all are taken into consideration to identify, how the leaves will look in the affected scenario. The changes are regularly realized by the coloring of leaves which turn yellow due to the typical green tissue since the annihilation of chlorophyll reduces. The parameters are gathered from the sensors and sent to cloud storage and the diseased plants are identified.

A convolution brain organization (CNN) is a sort of counterfeit brain network utilized in picture acknowledgment and handling that is explicitly intended to deal with pixel information. In CNN the neuron in a layer might be associated with a little district of the layer before it, rather than every one of the neurons in a completely associated way.

2. Objective

We are using Machine Learning for plant disease detection based on images of a leaf of a plant. The Convolution Neural Network algorithm is used because we are working with image data. The pi camera captures the sample leaves which are then sent to the CNN model. Then the leaf frame is sent to CNN model to identify whether the leaf is diseased or not. The output will be displayed in the LCD display. For security purposes we use an RFID module to switch ON/OFF the camera. It is used to prevent unwanted images from being captured.

3. Proposed System

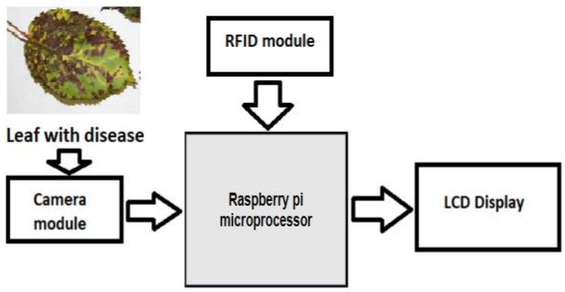

Fig.1. Block Diagram of Plant disease detection using CNN model

Fig.1 depicts the block diagram of the Plant disease detection system using CNN model. This system consists of Raspberry Pi, Camera module, RFID module and LCD display. The developed system collects leaf images which are processed using CNN model.

4. Working of Proposed System

In the proposed system shown in Fig.2, the Convolution Neural Network (CNN) algorithm for the plant leaf disease detection is used because the maximum accuracy can be attained with minimal loss. Training of the model is done using tensor flow. The accuracy of identifying the disease is proportional to the size of datasets. The CNN model has been trained with more than 7000 healthy leaves and 7000 infected leaves. The camera module captures the sample leaves which are then sent to CNN model. The CNN algorithm is used to decrease time complexity. Then the leaf frame is sent to CNN model to identify whether the leaf is diseased or not. The output will be displayed in the LCD display. The percentage of affected will also be calculated and be displayed in the LCD display. For security purposes we use an RFID module to switch ON/OFF the camera. It is used to prevent unwanted images from being captured.

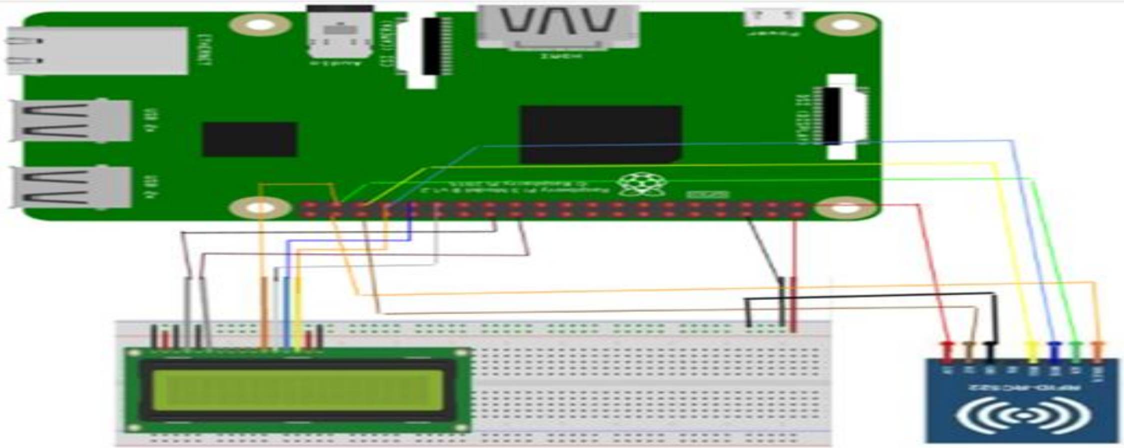

Fig.2. Connection Diagram of the proposed system

5. Simulation Results and Discussion

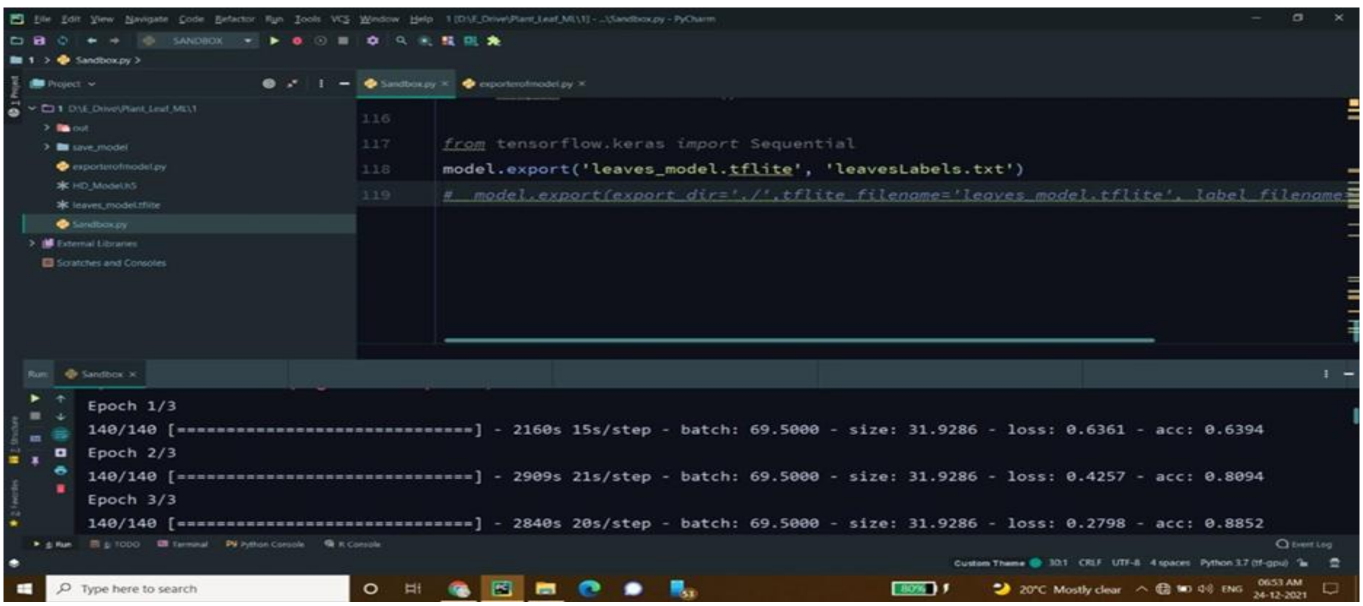

Fig.3. Trained CNN model

Trained CNN model is shown in Fig.3. The CNN classifiers are trained to detect whether the leaf is diseased or healthy. If the leaf is infected the model predicts the leaf as diseased, but if the leaf is not affected the model predicts the leaf as healthy. The CNN model consists of many layers which process the image in these layers which include Input and Output Layer, Convolution Layer, Soft-Max Layer, Connected Layer, Pooling Layer. Fig.4 shows the layers in a Convolution Neural Network. The trained model abolishes the demand for manual feature removal and extraction for the identification of images.

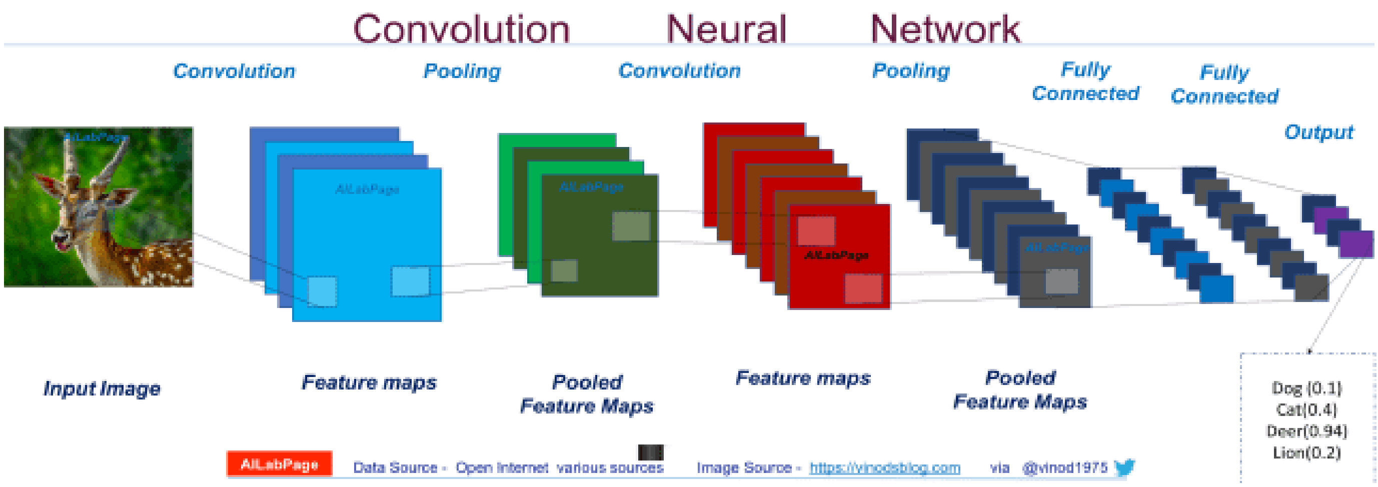

Fig.4. Layers in a Convolution Neural Network

Fig.5. shows a sample healthy leaf given as input to the CNN model and the output of the model is displayed as healthy through LCD display. The output of the CNN model is shown by the Fig.6.

Fig.5. Sample image of healthy Leaf

```
# Read class labels.
labels = ["healthy", "diseased"]

# Return the classification label of the image.
classification_label = labels[label_id] if label is None else label
print("Image Label is :", classification_label)

Model Loaded Successfully.
Image Shape ( 200 , 200 )
Classificaiton Time = 0.04 seconds.
Image Label is : healthy
```

Fig.6. Output of the CNN model

Fig.7. shows a sample infected leaf given as input to the CNN model and the output of the model is displayed as diseased through LCD display. The output of the CNN model is shown by the Fig.8.

Fig.7. Sample image of infected leaf

```
# Read class labels.
labels = ["healthy", "diseased"]

# Return the classification label of the image.
classification_label = labels[label_id] if label is None else label
print("Image Label is :", classification_label)
```

```
Model Loaded Successfully.
Image Shape ( 200 , 200 )
Classificaiton Time = 0.031 seconds.
Image Label is : diseased
```

Fig.8. Output of the CNN model

6. Hardware Configuration

The equipment execution of the framework is shown in Fig.9. What's more, their outcomes are confirmed. The RFID perused radiates a 13.56 MHz electromagnetic field that speaks with the RFID labels. The perused then speaks with the Raspberry Pi north of a 4-pin Sequential Fringe Point of interaction (SPI) with a most extreme information pace of 10Mbps. The equipment part depictions are recorded in the Table.1.

The contribution to the RFID user is given by interfacing it to the 3.3V pin of the Raspberry Pi module and the ground pin is associated with the GND. The LCD show takes input from the 5V pin of the Raspberry Pi and the ground pin associated with the GND pin of the Raspberry Pi.

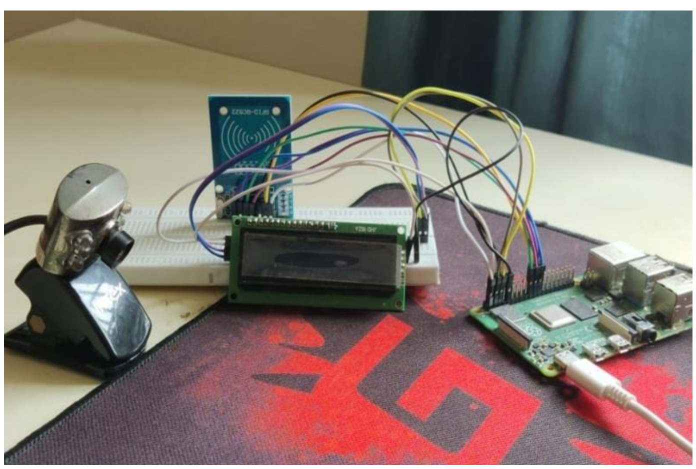

Fig.9. Plant Disease Detection model using Machine Learning

Table.1. Hardware Components Description

Component	Specification

Crystal PRO Webcam USB powered	640x480 resolution,
RFID Module 13.56 MHz Communication	RC522, 3.3V,
LCD Display5V DC, 16x2 Character display	
Raspberry Pi 4 Model B 1.5 GHz clock speed	2GB, 5V, 3A DC

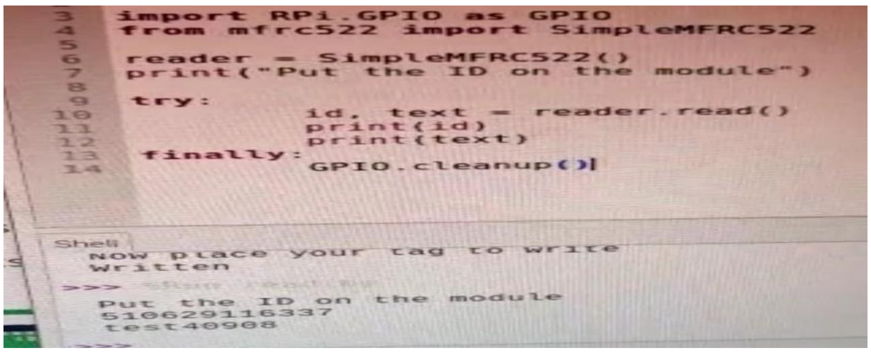

Fig.10. Output of the RFID module

Output of the RFID module is shown in Fig.10. The camera starts to capture images at 30 fps with a resolution of 640x480 which then sends the image data to the Raspberry Pi for processing using the trained convolution neural network model. If the images contain infected leaves the model predicts it as diseased and displays diseased in the display, if it predicts as healthy it prints as healthy.

7. Conclusion

Agricultural farming has been the key for human turn of events. Ranchers track down trouble in recognizing the sickness in the plants. There are numerous infections that influence the plants, where the side effects are not unmistakable at the absolute first stage which might prompt social and financial misfortunes. To make things more straightforward AI calculation is utilized, that assists with defeating these sorts of circumstances, by removing the elements of the leaves where the infections can be handily distinguished. It includes steps like picture securing, preprocessing, division, highlight extraction and grouping. Typically, ranchers or specialists notice the plants with eyes for distinguishing proof of illness. This paper gives a way to deal with the improvement of infection acknowledgment model, upheld leaf picture order, by the usage of Convolution Brain Organizations. This technique is another methodology in recognizing plant illnesses utilizing the AI model prepared and calibrated to suit precisely to the data set of a plants leaves that was assembled freely for different plant sicknesses. This model is empowered to recognize ailing leaves and sound ones from the climate by utilizing Convolution Brain Organization. The equipment model is created and the outcomes were noticed utilizing Tensor Stream. Correlation was made between equipment results and reenactment results. The model can effectively recognize the tainted and solid leaves.

Future work may include increasing the number of layers which may give highly accurate outputs and the model may be more efficient which can be implemented in more applications including autonomous drones, robots etc.

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