Leaf Disease Detection Using Image Processing

Aniket Gharat¹, Krupa Bhatt², Bhavesh Kanase³ & Abhilasha Bapnna⁴
B.E Student, Dept. of CSE, St. John college of Engineering & Management, Mumbai, India¹,²,³
Assistant professor, Dept. of CSE, St. John college of Engineering & Management, Mumbai, India⁴

Abstract: Leaf disease detection is basically a web application which make a uses of image processing and convolution neural network. For this purpose feature extraction of image will be perform. In feature extraction we use color (HSI model). The disease are classified by using convolution neural network. The system uses two image databases, one for training of already stored disease images and the other for implementation of query images. So we can use image processing for identification of leaf disease in JAVA. Identification of disease follows the steps like accepting the image from user, converting RGB to HSI, applying Hu’s moment algorithm extracting of features and CNN.

In our paper consider only 5 Disease of leaf. This paper discussed the methods used for the detection of leaf diseases using their leaf images Practical Implementation of Diseased Detection has been using OPENCV.

Keywords: Red Green Blue, Hue Saturation Intensity color Model, Convolutional Neural Network.

1. Introduction

Identification of the diseases is very important in any field to preventing the losses. Health monitoring and disease detection on plant is very critical for sustainable agriculture. The studies of the leaf diseases mean the studies of visually observable patterns seen on the leaf. Leaf disease detection requires huge amount of work, knowledge in the plant diseases, and also require the more processing time. Now a day’s technology plays vital role in all the fields but till today we are using some old methodologies in agriculture. If disease is wrongly detected it will leads to a loss of yield, time, production and money. We can use Image Processing techniques and Convolution Neural network together to for identification of diseases. The aim of this proposal was to develop a user friendly system for the farmers that will help them in determining detection diseases of leaves without bringing an expert to the field. We are selecting each thirty leaves of One Diseases. We are providing solution of diseases to the user. Practical implementation of neural networks has been done using JAVA.

2. Literature Survey

In the paper [1], the author says artificial neural network is used for training the image database and classified their performance to the respective disease categories. The experimental results express that what type of disease can be affected in the fruit and leaf. But Problem is in ANN we need to train the dataset every time. When a new query image can be inserted in the dataset. ANN should retrain the dataset which is very time consuming and it may be cause of error.

3. Proposed System

Our proposed system is to develop web application which helps the user to find disease of leaf. We are using Image processing and Convolution neural network latest techniques to give accurate and fast result to the user.

Proposed work focuses on detect the disease of leaf using image processing technique in OpenCv. The objective is to provide advanced image processing tools in a format that is user friendly and is inexpensive too. The study Aims to introduce an various algorithm which incorporates useful operations on leaf image including conversion RGB to HIS, Hu ‘moments and histogram. Here we perform analysis or feature extraction. After that we detect the disease of leaf done by Evolutional Clustering Method of convolutional neural network.

3.1 Methodology

3.1.1. Features for image classification

Color, Hu’s moment, and flood fill three feature vectors are used for feature extraction.
1. **color (HSI Model)**

The input image is basically in RGB color model. The RGB color model is an additive system in which each color is defined by the amount of red, green, and blue light emitted. In RGB color model, colors are represented in numerical value R(0 to 255), G(0 to 255), B(0 to 255).

HSI color model, which encodes colors according to their Hue, Saturation, and Intensity. The HSI model is used by some graphics programs and color monitors as an alternative to, or alongside the RGB representation.

**RGB to HSI Conversion Formula**

\[
H = \begin{cases} 
\theta & \text{if } B \leq G \\
360 - \theta & \text{if } B > G 
\end{cases}
\]

\[
\theta = \cos^{-1} \left( \frac{1}{2} \left[ \frac{1}{2} \left( |R-G| + |R-B| \right) \right] \right)
\]

\[
S = 1 - \frac{3}{R + G + B} \min(R, G, B)
\]

\[
I = \frac{1}{3} (R + G + B)
\]

![Image of HSI conversion steps]

2. **Hu’s moment algorithm**

This algorithm is used for analyzing shapes obtained from a collection of their leaf images.

M-K Hu [21] proposes 7 moment features that can be used to describe shapes and these are invariant to rotation, translation, and scaling. For a digital image, the moment of a pixel at location is defined as the product of the pixel value with its coordinate distances i.e., the moment of the entire image is the summation of the moments of all its pixels. More generally, the moment of order of an image is given by \(p, q\) of an image \(I(x,y)\) is given by

\[
m_{p,q} = \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} f(x,y)x^p y^q
\]

The first four Hu invariant moments which are invariant to rotation are defined as follows:
To make the moments invariant to translation the image is shifted such that its centroid coincides with the origin of the coordinate system. The centroid of the image in terms of the moments is given by:

\[ x_c = \frac{m_{10}}{m_{00}} \]
\[ y_c = \frac{m_{01}}{m_{00}} \]

Then the central moments are defined as follows:

\[ \mu_{pq} = \sum_{x} \sum_{y} [(x - x_c)^p (y - y_c)^q I(x, y)] \]

3. Flood Fill Algorithm:
Very important algorithm for segmentation is flood fill, also known as region growing. Although it might look like a very simple algorithm at first sight, it has a very interesting implementation and has several parameters that can make it work well to segment images. The idea behind the algorithm is to check for connected components, which are the areas with similar color or brightness, starting from a given point—the so-called seed point—and then examining this particular point's neighbors. These can include either 4 (north, south, east, and west) or 8 neighbors (north, north-east, east, south-east, south, south-west, west, and north-west) that check for a condition and then recursively, call the same procedure on each of the neighbors in case they have passed that condition.

3.1.2. Role of CNN in image classification
After feature extraction, learning database images are classified by using neural network.
CNN accept all future new query images for image classification and therefore every time need not to be train testing database.
Convolutional neural networks (CNNs) consist of multiple layers of receptive fields. These are small neuron collections which process portions of the input image. The outputs of these collections are then tiled so that their input regions overlap, to obtain a higher-resolution representation of the original image; this is repeated for every such layer. Tiling allows CNNs to tolerate translation of the input image.

Evolutionary clustering Mechanism with CNN:
Similar as K-Means clustering using ECM we can classify the images and detect the Disease.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>ANN</th>
<th>CNN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faster</td>
<td>Less</td>
<td>more</td>
</tr>
<tr>
<td>Retrain the new input</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>automatically</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>50-60%</td>
<td>60-88%</td>
</tr>
</tbody>
</table>

Table 3.1: Classification Result

<table>
<thead>
<tr>
<th>Alternaria</th>
<th>Anthracnose</th>
<th>Bacterial Blight</th>
<th>Cercospora</th>
<th>Leaf</th>
</tr>
</thead>
</table>
Alternaria Alternata  | 23 | 2 | 0 | 0
Anthracnose          | 0  | 24| 0 | 0
Bacterial Blight     | 0  | 0 | 25| 0
Cercospora Leaf Spot | 0  | 0 | 0 | 25

<table>
<thead>
<tr>
<th>Alternata</th>
<th>Spot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternaria Alternata</td>
<td>23</td>
</tr>
<tr>
<td>Anthracnose</td>
<td>0</td>
</tr>
<tr>
<td>Bacterial Blight</td>
<td>0</td>
</tr>
<tr>
<td>Cercospora Leaf Spot</td>
<td>0</td>
</tr>
</tbody>
</table>

4. Technologies Used/Software

4.1 IMAGE PROCESSING

Image processing for which the input is an image, a series of images, or a video, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image.

4.2 CNN USING TENSERFLOW

TensorFlow provides multiple APIs. The TensorFlow layers module provides a high-level API that makes it easy to construct a neural network. It provides methods that facilitate the creation of dense (fully connected) layers and convolutional layers, adding activation functions, and applying dropout regularization.

4.3 ANACONDA

Anaconda is an easy-to-install free package manager, environment manager, Python distribution, and collection of over 720 open source packages offering free community support.

4.4 CRONTAB

The crontab is a list of commands that you want to run on a regular schedule, and also the name of the command used to manage that list. cron is the system process which will automatically perform tasks for you according to a set schedule. The schedule is called the crontab, which is also the name of the program used to edit that schedule.

5.EXPERIMENTAL RESULT

The final results of the designed system are given below. From those results we get the detailed information to image uploading and detected disease result with confidential ratio. The output images given as below.

Fig1: Architecture Diagram
Step 1: The GUI where user can select an image to upload.

![System GUI](image1.png)

**Fig 5.1 – System GUI**

Step 2: User have to upload the image by clicking on choose file tab and then select the input image it shown in the figure 5.2

![System GUI for Uploading Image](image2.png)

**Fig 5.2 – System GUI for Uploading Image**

Step 3: The disease is detected by applying proposed techniques. After the processing on the input image the system will detect the disease and the confidence ratio of matching in the scale of 0 to 1. Fig 5.3 shows the result of disease detection with score of confidence ratio.
6. Future Scope

Using new Different technologies and method we can make more faster and efficient application for user. The system presented in this project was able to perform accurately, however there are still a number of issues which need to be addressed. First of all, we consider only four diseases in this project therefore the scope of disease detection is limited. In order to increase the scope of the disease detection large datasets of different disease should be use.

7. Conclusion

After reviewing above mentioned techniques and methods we can conclude that there are number of ways by which we can detect disease and nutrient deficiency of Leaf. Each has some pros as well as limitations. On one hand visual analysis is least expensive and simple method, it is not as efficient and reliable as others are. Image processing is a technique most spoken of very high accuracy and least time are major advantages offered.

8. Acknowledgements

Special thanks go to our guide professor Abhilasha Bapnna contributed to this paper for their valuable comments and sharing their knowledge and idea. We also thank our friends for their feedback and discussion with us.

9. References


[3] Mr. Sachin B. Jagtap1, Mr. Shailesh M. Hambarde2 “Agricultural Plant Leaf Disease Detection and Diagnosis Using Image Processing Based on Morphological Feature Extraction” university Of Pune, Jspm’s Jscoe, Pune, India.


[7] 1Suneeta Budihal, 2Sandhya R., 3Soumya D Hajawagol, 4Soumya R Navi B.V.B.C.E.T., Hubli, India,” Detection of Disease in Tomato Leaf”.
network technique” Electric Circuits Analysis Laboratory, Department of Electrical and Computer Engineering.

Democritus University of Thrace, 67100 Xanthi, Greece.