

Application of Raspberry-Pi model for Plant Disease Detection

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Abstract—Agriculture with its associated sectors is undoubtedly the largest livelihood provider in India. Today, in agriculture plant disease is the significant concern as it reduces the production and quality of food. Hence there is a need to detect the plant diseases at the early stage. Banana leaf is highly exposed to diseases like Black Sigatoka, Yellow Sigatoka, Bunchy top, Panama Wilt, Streak virus. The detection of plant leaf diseases requires close observation. Finally solution for automatic plant disease detection and finally the percentage infection raspberry pi with using image processing technique. Image processing techniques are employed to enhance the quality of images. Besides, the proposed work uses Artificial Neural Network to classify the Banana plant diseases and Artificial neural network based training and classification. Finally a system is developed that extracts the features from images and classifies the diseases.

Keywords—ANN; SVM; RASPBERRY PI 3; RASPERRY-PI, DC MOTOR; MATLAB.

I. INTRODUCTION

Agriculture is the main occupation of India. 70% of the population depends on agriculture either directly or indirectly. The nation's economy depends on agriculture. It additionally contributes a noteworthy figure to the Gross Domestic Product (GDP). Plant diseases, which are generally caused by viruses, bacteria, fungi, nematode and nutrient deficiency, cause lots of damage to crops and its affects are – reduces the yield and quality of crops. It also results in death of the plant, affects the income of the farmer and also increases the cost of production over the span of controlling them. Banana is the most vital fruit consumed in the Asia and pacific regions. Banana plant is affected by various diseases, whose symptoms appear on leaves. The diseases are Black Sigatoka, Yellow Sigatoka, Banana Bunchy Top Virus, Streak virus, Panama wilt.

1.1 Banana Bunchy Top Virus

Banana Bunchy Top is the most severe viral disease of Banana caused by single- stranded DNA virus. Symptoms of this disease are- the newer leaves are narrower, yellow and cause a bunchy like appearance. Another symptom visible on the leaf is “Morse code streaking” which gives dark color dash like appearance on the leaf surface and also the edge of some leaves are rolled upwards. This disease can be controlled by spraying Meta-systox (0.1- 0.5%). It can also be controlled by uprooting the infected plants.



Fig 1.1: Banana Bunchy Top Affected leaf

1.2 Black Sigatoka

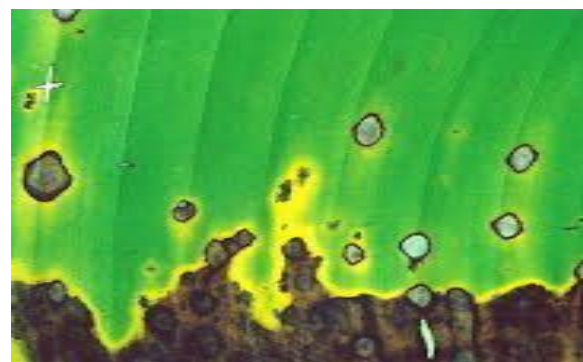


Fig 1.2: Black sigatoka affected leaf

Black Sigatoka is basically a leaf spot disease of the Banana plant caused by *Mycosphaerella fijiensis*. The disease symptoms are red/brown spots with yellow border on edges of leaves. It is spread by wind. It is the most dominant disease of Banana all over the world. This disease can be controlled by regular fungicide applications and by increasing the spacing between plants to augment air circulation and reduce moistness

1.3 Yellow Sigatoka

Yellow Sigatoka is another leaf spot disease of Banana plants caused by *Mycosphaerella musicola*. The disease symptoms are small yellow spots with gray centre and yellow border on upper side of leaves. It is spread by wind and rain. The disease can be controlled by the application of Thiophante methyl

(1g/1 liter of water) or bordraux mixture 0.1% + 2% linseed oil. The suckers to be planted should be disease free and dipped in fungicide solution prior to planting.



Fig 1.3: Yellow Sigatoka affected leaf

1.4 Panama Wilt



Fig 1.4: Panama Wilt affected leaf

Panama wilt is a disease of the roots caused by *Fusarium Oxysporum*. The symptoms of this disease are yellowing of the leaves starting from the edge and extending to midrib of the leaves. Pseudo stem splitting longitudinally. The disease can be controlled by soaking of suckers in carbendazium (10g/10 liters of water) before planting, application of bioagents such as *Trichoderma Viride* in soil. Severely affected plants should be evacuated.

1.5 Banana Streak Virus Disease



Fig 1.5: Banana Streak

Virus affected leaf Banana Streak Virus is a virus of the family *Caulimoviridae*. The symptoms of this disease are chlorotic streaks on midrib of leaves and splitting of pseudo-stem. This disease can be controlled by using clean planting material and detention. Most of the farmers are uneducated and they do not get correct and complete information of the diseases of plants, they need expert advice. Since it is not possible for the plant pathologists to reach at every farm and as even the plant pathologists rely on manual eye observation, the manual

prediction method is not so accurate. Therefore, there is a need to design an automatic leaf disease detection system that assists the farmers in early detection of the diseases with greater accuracy.

II. LITERATURE SURVEY

The problem of leaf disease detection has been an issue since long time and is of great concern in agriculture area for quality management of the crop. Some already proposed systems in the area are as explained below.

In 2018, Roshan Helonde has a done is that they have "MATLAB Project for Plant Disease Detection and Classification on Leaf Image using Image Processing Full Source Code", Disease decrease the productivity of plant which restrict the growth of plant and quality of plant also reduces. There are difference feature extraction technique for extracting the color, texture and edge feature such as color space, color histogram, gray level co-occurrence matrix (CCM), Gabor filter, Canny and Sobel edge detection. Disease is caused by pathogen in plant at any environment condition . In most of the case disease are seen on the leaves, fruites and stems of the plant, therefore detection of disease plays an important role in successful cultivation of crops. In most of cause plant disease are caused by pathogens, microorganism, fungi, bacteria, viruses, ect. Sometime unhealthy environment include soil and water is also responsible for disease in plant.

In 2018, Ms.Nidhi Rajesh Savaji has a done is that they have "Plant Disease Detection Using Image Processing" There are many diseases that have an effect on plants with the potential to cause economic and social losses. Diseases in crops, totally on the leaves, affects on the reduction of each quality and amount of agricultural product. If the diseases don't seem to be detected at initial stage, then it's a lot of harmful to production. To seek out the explicit disease victimization, image processing helps to seek out the disease and to forestall the disease as early as attainable. Disease detection involves the steps like image acquisition, image pre-processing, image segmentation, feature extraction and classification. This paper additionally mentioned some segmentation and have extraction formula employed in the disease detection. Initially, it is difficult to develop one general system to detect every type of disease. This paper proposed the system for limited type of disease, So in future, the work should be extended by concoction of different techniques for better identification.

In 2018, Rashmi Sollapure has a done is that they have "Plant Leaf Disease Detection Based on Image Processing Using MATLAB "The plant leaf diseases are effecting the productivity quality and efficiency of the plants, thus effecting the growth of the country. To overcome this plant leaf diseases must be recognized during initial stages. The proposed scheme is based on the image processing technique using MATLAB. Earlier linear support vector machine was used to identify single diseases. The machine learning methods bring this aspect to reality, by observing the database and helping the botanists in diagnosis of diseases where lot of precision is required. And one of the machine learning technique, SVM is used in this project for classification of leaf diseases.

In 2018, Hailay Beyene has a done is that they have“ Plant Diseases Prediction Using Image Processing and Machine Learning Techniques: Survey” As a result, in this survey, different machine learning techniques, such as Artificial Neural Network, Support vector machine, Convolutional neural network, K-nearest neighbor, Nave bayes, Radial basis function, Self organizing map, Fuzzy inference system, minimum distance criterion, least square support vector machine, Feed forward neural network and learning vector quantization were used and their significances are also described. Though the proposed techniques can help farmers at least in minimizing the effects of the diseases, none of these techniques describe the severity of each disease, are only used to predict plant leaves diseases and are applied only to specific types of plant leaf diseases.

III. METHODOLOGY

The leaf’s image being captured using digital Camera with a white background, the image is to be loaded for processing. Then Identifying and compare the features such as color and texture to check whether the Leaf is healthy or not.Capture the image of the leaf (RGB leaf acquisition).Then it has to be converted from RGB to colour format for further processing. Then we should obtain the useful segments of the leaf for computing. Then we should compute and compare the texture features of the leaf obtained by the image. Compute or obtain the value and compare with the range values. Finally find the disease and apply the respective pesticide. extraction, feature file creation, wherein a set features are selected and computed during the feature extraction phase which are used further for classification of the disease. This automatic Banana plant disease recognition system can replace the manual method for recognizing the diseases and is going to be very helpful for the farmers or plant pathologists in determining the disease and its control measures, as it is more accurate than manual method. The dataset folder is created which consists of various images required for testing. The query image is resized into a fixed pre-set dimension. Then the resized image is transformed from RGB to gray image

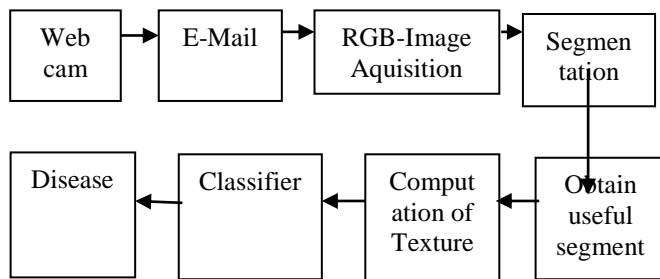


Fig 3.6 block diagram

The feature are extracted from RGB to gray image and the disease is classified. In this project we have proposed feature extraction based concept of detecting disease using automotive method for respective pesticide. Provide accuracy of detection and identification.

WEBCAM:

A webcam is a camera that feeds or streams its image in real time to or through a computer to a computer network. When

"captured" by the computer, the picture stream may be saved, viewed or sent on to other networks travelling through systems such as the internet, and e-mailed as an attachment. When sent to a remote location viewed or on sent there a webcam is generally connected by a built into computer hardware, such as laptops.

E-mail:

After the webcam is stored an image e-mail through notification get the user.

RGB image acquisition:

The acquired image are dissimilar in dimensions hence we resize the image to uniform 256*256 dimension for efficient processing. RGB image converted to gray and color space. Gray scale images are simple to process, as they contain only intensity values. RGB is suitable for color generation

Segmentation:

Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super-pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics.

IV. WORKING PRINCIPAL

4.1 FEACTURES EXTRACTION.

4.1.1 Mean

The sample mean is the average and is computed as the sum of all the observed outcome from the sample divided by the total number of events. We use x as the symbol for the sample mean. In math terms,

$$\bar{x} = \frac{\sum x}{N}$$

$\sum x$ = the sum of x

N = number of data

4.1.2 Standard Deviation

The standard deviation is a statistic that measures the dispersion of a dataset relative to its mean and is calculated as the square root of the variance. It is calculated as the square root of variance by determining the variation between each data point relative to the mean. If the data points are further from the mean, there is a higher deviation within the data set; thus, the more spread out the data, the higher the standard deviation

The sample standard deviation of the metabolic rate for the female fulmars is calculated as follows. The formula for the sample standard deviation is

$$\sigma = \sqrt{\frac{\sum(X-\bar{X})^2}{n}}$$

σ = lowercase sigma
 \sum = capital sigma
 \bar{X} = X bar

where X_i are the observed values of the sample items, \bar{X} is the mean value of the observations and N is the number of observations in the sample.

4.1.3 Entropy

Entropy is a thermodynamic function used to measure the randomness or disorder of a system. For example, the entropy of a solid, where the particles are not free to move, is less than the entropy of a gas, where the particles will fill the container. Scientists have concluded that if a process is to be spontaneous, the entropy of that process must increase. This includes the entropy of the system and the entropy of the surroundings.

Entropy can be calculated using many different equations:

1. If the process is at a constant temperature then $\Delta S_{system} = \frac{q_{rev}}{T}$, where ΔS is the change in entropy, q_{rev} is the reverse of the heat, and T is the Kelvin temperature.

2. If the reaction is known, then ΔS_{rxn} can be calculated using a table of standard entropy values.

$$\Delta S_{rxn} = \sum \Delta S_{products} - \sum \Delta S_{reactants}$$

3. Gibbs free energy (ΔG) and enthalpy (ΔH) can also be used to calculate ΔS .

$$\Delta G = \Delta H - T\Delta S$$

4.1.4 RMS

In a direct current (DC) circuit, voltage or current is simple to define, but in an alternating current (AC) circuit, the definition is more complicated, and can be done in several ways. Root-mean-square (rms) refers to the most common mathematical method of defining the effective voltage or current of an AC wave.

To determine rms value, three mathematical operations are carried out on the function representing the AC waveform:

- (1) The square of the waveform function (usually a sine wave) is determined.
- (2) The function resulting from step (1) is averaged over time.
- (3) The square root of the function resulting from step 2 is found.

4.1.5 Variance

Variance (σ^2) is a measurement of the spread between numbers in a data set. It measures how far each number in the set is from the mean and is calculated by taking the differences between each number in the set and the mean, squaring the differences (to make them positive) and dividing the sum of the squares by the number of values in the set.

Variance is one of the key parameters in asset allocation. Along with correlation, the variance of asset returns helps investors to develop optimal portfolios by optimizing the return-volatility trade-off in investment portfolios.

The square root of variance is the standard deviation (σ).

1) The Formula for Variance

$$\sigma^2 = \frac{\sum(X_i - \bar{X})^2}{N}$$

σ^2 = variance
 X_i = the value of the i^{th} element
 \bar{X} = the mean of X
 N = number of elements

4.1.6 Smoothness

"Smooth curve" redirects here. For the equivalent concept in algebraic geometry, see singular point of an algebraic variety."C infinity" redirects here. For the extended complex plane, see Riemann sphere.

In mathematical analysis, the smoothness of a function is a property measured by the number of derivatives it has that are continuous. A smooth function is a function that has derivatives of all orders everywhere in its domain.

4.1.7 Kurtosis

This page explains the formula for kurtosis, excess kurtosis, sample kurtosis, and sample excess kurtosis. Kurtosis is one of the summary statistics; it is used for describing or estimating a distribution's peakiness and frequency of extreme values. You can easily calculate kurtosis in Excel using the Descriptive Statistics Excel Calculator. If you don't want to go through the lengthy derivation and explanation below, the formulas are here the Population Kurtosis Formula is

$$K = n \frac{\sum_{i=1}^n (X_i - X_{avg})^4}{(\sum_{i=1}^n (X_i - X_{avg})^2)^2}$$

4.1.8 Skewness

This page explains the formula for population and sample skewness. Skewness is one of the summary statistics; it is used for describing or estimating symmetry of a distribution (relative frequency of positive and negative extreme values). Skewness is very important in portfolio management, risk management, option pricing, and trading. You can easily calculate skewness in Excel using the Descriptive Statistics Excel Calculator. Skewness Formula is

$$S = \sqrt{n} \frac{\sum_{i=1}^n (X_i - X_{avg})^3}{(\sum_{i=1}^n (X_i - X_{avg})^2)^{3/2}}$$

4.1.9 IDM

IDM is a tool to increase download speeds by up to 5 times, resume and schedule downloads. Comprehensive error recovery and resume capability will restart broken or interrupted downloads due to lost connections, network problem, computer shutdowns, or unexpected power outage. Simple graphic user interface makes IDM user friendly and easy to use. Internet Download Manager has a smart download logic to accelerate downloads. Unlike other download managers and accelerators Internet Download Manager segments downloaded files dynamically during download process and

reuses available connections without additional connect and login stage to achieve best acceleration performance.

4.1.10. Contrast

To contrast something is to look for differences among two or more elements, but compare is to do the opposite, to look for similarities. It's easy to tell the difference if you remember that contrast comes from the Latin root *contra*, and means "against."

4.1.11 Correlation

Correlation is very helpful to investigate the dependence between two or more variables. As an example we are interested to know whether there is an association between the weights of fathers and son. correlation coefficient can be calculated to answer this question. If there is no relationship between the two variables (father and son weights), the average weight of son should be the same regardless of the weight of the fathers and vice versa

4.1.12 Energy

Physicists, who are scientists who study force, motion and energy, say that energy is the ability to do work, and work is moving something against a force, like gravity. Energy can be found in many things, and takes many forms. There is a kind of energy called kinetic energy in objects that are moving. For the gravitational force the formula is $P.E. = mgh$, where m is the mass in kilograms, g is the acceleration due to gravity (9.8 m/s^2 at the surface of the earth) and h is the height in meters. Notice that gravitational potential energy has the same units as kinetic energy, $\text{kg m}^2 / \text{s}^2$.

4.1.13 Homogeneity

Physics, a homogeneous material or system has the same properties at every point; it is uniform without irregularities. A uniform electric field (which has the same strength and the same direction at each point) would be compatible with homogeneity (all points experience the same physics). A material constructed with different constituents can be described as effectively homogeneous in the electromagnetic materials domain, when interacting with a directed radiation field (light, microwave frequencies, etc.).

Mathematically, homogeneity has the connotation of invariance, as all components of the equation have the same degree of value whether or not each of these components are scaled to different values, for example, by multiplication or addition. Cumulative distribution fits this description. "The state of having identical cumulative distribution function or values".

V. RESULT AND ANALYSIS

This paper consist of Automated System technique. Which uses Image Processing for the transmission Of an Image and finding a diseases in a Banana leaf. The Working of this model is explains in such a way are using Raspberry Pi 3 four built-in USB ports provide enough connectivity for a mouse, keyboard, or anything else that you feel the RPi needs, but want to add even more you can still use a USB hub. Powering the Raspberry Pi 3 is easy, just plug any USB power supply

into the micro-USB port. There's no power button so the Pi will begin to boot as soon as power is applied, to turn it off simply remove power. The four built-in USB ports can even output up to 1.2A enabling you to connect more power hungry USB devices (This does require a 2Amp micro USB Power Supply). On top of all that, the low-level peripherals on the Pi make it great for hardware hacking. The 0.1" spaced 40-pin GPIO header on the Pi gives you access to 27 GPIO, UART, I2C, SPI as well as 3.3 and 5V sources. Each pin on the GPIO header is identical to its predecessor the Model B+.

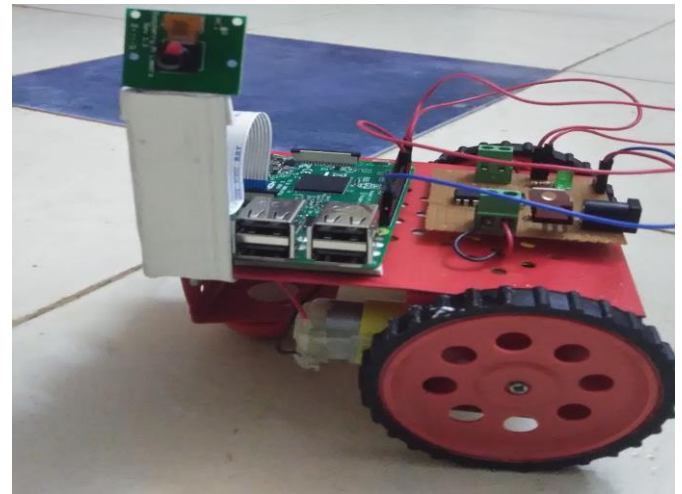


Fig 5.1 Overall module with Raspberry pi 3

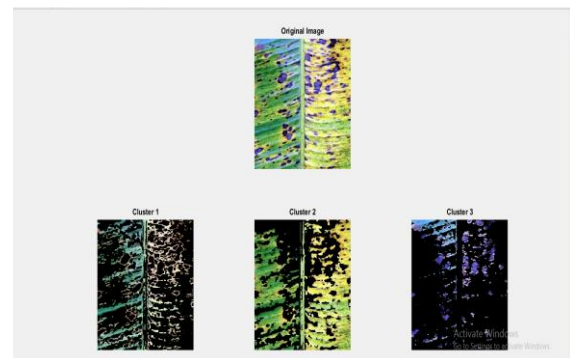
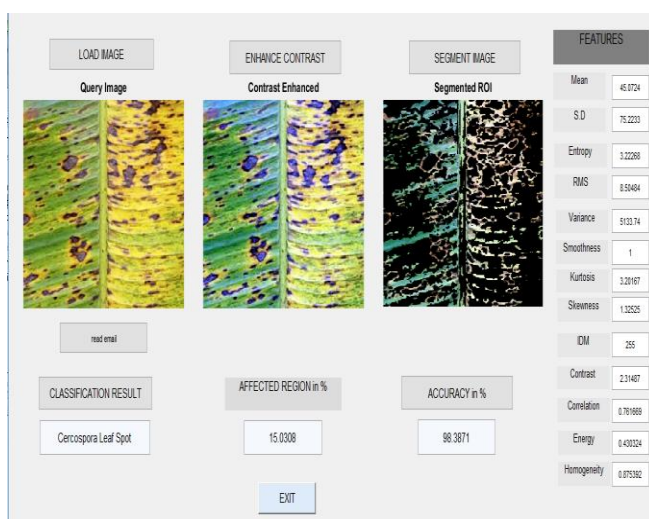


Fig 5.2 result

When Program is Dumped on the system. Now its Ready to Run for Raspberry Pi Camera is Automat moves by capturing the image of Banana leaf and identifier the disease. The results



5.2 Result

VI. CONCLUSION AND FUTURE SCOPE

The present study deals with automatic disease detection of plant leaf of banana using image processing techniques. It involves image acquisition, image preprocessing, image segmentation, feature extraction and classification. Development of automatic detection system using advanced computer technology such as image processing help to support the farmers in the identification of diseases at an early or initial stage and provide useful information for its control. The system would like to extend our work further on more plant disease detection.

Data mining technologies has been incorporated in the agriculture industry. This project implements an innovation idea to identify the affected crops and provide remedy measures to the agriculture industry. By the use of SVM-mean clustering algorithm, the infected region of the leaf is segmented and analyzed. The image are fed to our application for the identification of disease. It provides a good choice for agriculture community particularly in remote village. It acts as an efficient system in terms of reducing clustering time and the area of infected region.

The Banana plant disease detection system is developed using the Matlab application. The system developed

involves images acquisition, pre-processing, feature extraction, feature file creation, wherein a set of features are selected and computed during the feature extraction phase which are used further for classification of the disease. This automatic Banana plant disease recognition system can replace the manual method for recognizing the diseases and is going to be very helpful for the farmers or plant pathologists in determining the disease and its control measures, as it is more accurate than manual method. The dataset folder is created which consists of various images required for testing. The query image is resized into a fixed pre-set dimension. Then the resized image is transformed from RGB to gray image. The feature are extracted from RGB to gray image and the disease is classified. In this project we have proposed feature extraction based concept of detecting disease using automotive method for respective pesticide. Provide accuracy of detection and identification.

System shows leaf disease detection of banana using digital image processing techniques.

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