

# Tomato Leaf Disease Detection using K-Means, SVM Classifier & Neural Networks



C. K. Sampoorna, K. Rasadurai

**Abstract:** Agriculture is that the mainstay of the Indian economy. Nearly 56% of individuals depend on it & shares major a neighborhood of the Gross domestic product. Out of that tomato is one among the simplest common food crops in Asian nation. Diseases in crops wholly on the leaves affects on the reduction of every quality and quantity of agricultural merchandise. Perception of human eye is not such a great deal stronger so on observe minute variation inside the infected a part of leaf. Throughout this paper providing software package resolution to automatically observe and classify plant leaf diseases. Throughout this we have a tendency to area unit exploitation image method techniques to classify malady's & quickly designation are administrated as per disease. This approach will enhance productivity of crops. Throughout this project four leaf diseases area unit supported. It includes several steps wise image acquisition, image pre-processing [9], segmentation, options extraction, K-means, neural network & SVM classification. The look and implementation of Otsu segmentation technologies area unit absolutely automatic and it provides accumulated productivity. For tremendous use of chemical and to scale back the economic loss, the identification of disease severity is main issue. Inside the context of sensible farming, we address the challenge of event IOT with Raspberry pi and sensors with image method to reinforce the efficiency of the agriculture.

**Index terms -** IOT, green House, Agriculture, Image process, Raspberry Pi, Soil wet detector, UV Sensor, humidity sensor, K-means, SVM and CNN classifier.

## I. INTRODUCTION

Agriculture has complete a key role among the event of human civilization. If there is decrease in agro product, total economy will get affected. Therefore even bimanual management of all input resources like soil, seed, water, fertilizers is crucial for property. Agriculture isn't alone to feed ever growing population but it's put together very important offer of energy. Plant diseases have a bearing on each quality and quantity of crops in agriculture production. Disease designation is very essential in earlier stage so as to forestall and management them. The optic observation of

consultants is that the most approach adopted sure detection and identification of plant diseases. But the optic observation is time intense, expensive and take plenty of efforts. To get rid of drawbacks in existing system many system are projected to beat those drawbacks by victimization completely different techniques. Among ensuing section this paper tries to gift those projected systems in pregnant manner. The management of crops required shut examination notably for management of unhealthiness infected crop that will have a bearing on the standard and quantity of crop. Image method is associate best technique for agricultural application. Image method can discover associate pest's attack from the image of plant. The detection and classification of plant diseases area unit very important task to extend plant productivity. There are a unit varied techniques emerged to watch the malady like thresholding, region growing, clustering, Edge based detection etc. To discover malady the image got to bear some method like pre-processing, segmentation, feature extraction and classification processes. The pre-processing is associate improvement technique of image data to suppress unwanted distortion or enhances some image choices vital for added method. The segmentation method is to partition an image into pregnant regions and its vital technique through that image choices area unit extracted. There are varied choices of an image like gray level, color, texture, shape, depth, motion, etc. Classification technique is utilized to classify the given input data into type of classes and groups. It classifies the information based mostly upon hand-picked choices. Here describes feature regularization and extraction technique by this detection of 3 diseases area unit typically done. This technique has extra accuracy, than that of the alternative feature detection techniques. With this system regarding ninetieth of detection of Red spot i.e. fungous unhealthiness is detected. Projected image method based work is consists of the following main steps: among the commencement the uninherited footage area unit divided victimization the K-means techniques. In, designation system for grape leaf diseases is proposed. The projected system consists of three main parts: initial of all Segmentation, second grape disease feature extraction and eventually grape disease classification. Developed a fast and correct methodology for detection and classification of plant diseases.

In the next step, the segmentation is completed by victimization K-means clump technique. Afterwards the in the main in skilled pixels are disguised. Extra the pixels with zero inexperienced, red and blue values and so the pixels on the boundaries of the infected object were completely removed. Then the infected cluster was regenerate into HIS format from RGB format. Among ensuing step, for every component map of the image for fewer than HIS footage the SGDM matrices were generated.

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Finally the extracted feature was recognized.

India is associate agricultural country whereby most of the population depends on agriculture. Analysis in agriculture is aimed towards increase of productivity and food quality at reduced expenditure, with inflated profit.

Agricultural production system is associate outcome of a flowery interaction of soil, seed, and agro chemicals. Vegetables and fruits are the foremost necessary agricultural product. Thus on acquire heaps of valuable product, a product control is essentially necessary. Many studies show that quality of agricultural product might even be reduced due to plant diseases. Diseases area unit impairment to the standard state of the plant that modifies or interrupts its vital functions like natural action, transpiration, impregnation, fertilization, germination etc. These diseases are caused by pathogens viz., fungi, microorganism and viruses, and since of adverse environmental conditions. Therefore, the primary stage designation of malady is a very important task. Farmers want continuous observation of consultants that may be prohibitively dear and time overwhelming. Thus making an attempt to search out fast, less expensive and proper technique to automatically realize the diseases from the symptoms that appear on the plant leaf is of nice realistic significance. This enables machine vision that's to supply image based automatic review, method management and mechanism steering.

## A. CLASSIFICATION OF DISEASES

### • **EARLY BLIGHT:**

Early blight is caused by two fully completely different closely connected fungi, *Alternariatomatophila* and *Alternariasolani*. *Alternariatomatophila* is extra virulent on tomato than *A. solani*, so in regions where *A. tomatophila* is found, it is the initial reason for early blight on tomato. However, if *A. tomatophila* is absent, *A. solani* will cause early blight on tomato. Every pathogens will even infect potato, although *A. solani* is extra doubtless to cause potato early blight than *A. tomatophila*. Every pathogens will even infect eggplant and a number of other asterid magnoliopsid family weeds at the side of poisonberry (*Solanumptycanthum*), and hirsute vascular plant.

### • **SEPTORIA LEAF SPOT:**

Septoria leaf spot is caused by a plant, *Septorialycopersici*. It one among the foremost damaging diseases of tomato foliage and is very severe in areas where wet, wet weather persists for extended periods.

### • **BACTERIAL SPOT:**

Bacterial spot is caused by four species of genus and happens worldwide wherever tomatoes are massive. Bacterial spot cause's leaf and fruit spots that finally ends up in defoliation, sun-scalded fruit, and yield loss. Due to *diversity* at intervals the being spot pathogens, the malady can occur at fully completely different temperatures and should be a threat to tomato production worldwide. Disease development is favored by temperatures of seventy five to eighty six °F and high precipitation.

### • **IRON CHLOROSIS:**

Iron chlorosis affects many forms of plants and may well be frustrating for a gardener. Associate iron deficiency in plants causes unpleasant yellow leaves and eventually death. So it's a necessity to correct iron deficiency anemia in plants. Let's

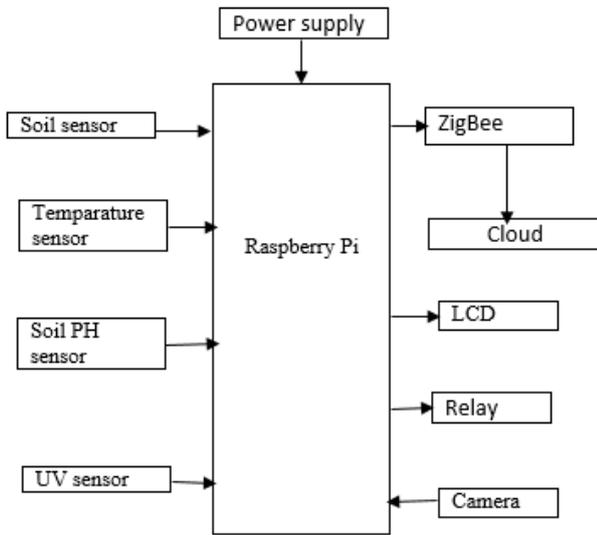
look into what is going to iron do for plants and therefore the thanks to repair general iron deficiency anemia in plants.

## B. IMPLEMENTATION OF PROJECT

There are some ways in which describing detection the plant leaves diseases by practice automatic detection and Classification of diseases. The foremost well-liked approaches for classification are K-means and fuzzy algorithmic rule that based on their bunch efficiency. Fuzzy bunch algorithmic program is clump algorithmic program that is wide applied wide range of issues connected with feature analysis, bunch and classify vogue. Fuzzy bunch techniques area unit within the main based fuzzy behavior which they provide the simplest way that's manufacturing a bunch. Another well-liked methodology is K-means that primarily partitioning methodology applied to analysis and treat observation data as object supported location and distance between various knowledge points. Partitioning the article into manual cluster(K)is done by it in such how that object inside each cluster keep as almost each other but such a lot from object in various cluster. Unwellness spots area unit completely totally different in color. The color transform of RGB image is used for higher segmentation of unwellness spots. RGB color feature segmentation is consist with unwellness spots. The projected approach consists of four steps like segmentation, Feature extraction and classification. The image segmentation uses the K-means bunch technique. The options objects unit extracted from the segmental image which segmental footage unit classified supported associate degree Otsu Segmentation. The input image of grape leaf is sophisticated at background. The preprocessing is used to enhance image information suppress unwanted distortion. Then, segmentation is finished through K-means bunch technique. The pathologic portion is understood by practice segmentation. K-means bunch is used for segmentation and is in addition used for classification of choices

This project presents tomato plant disease Detection exploitation K means, CNN and SVM classifiers beside the employment of devices like Raspberry Pi with image method. Python linguistic communication and MATLAB is used for automation purpose. This project contributes a cost-effective and fairly low cost automation irrigation system. System once place in has less maintenance price and is straightforward to use.

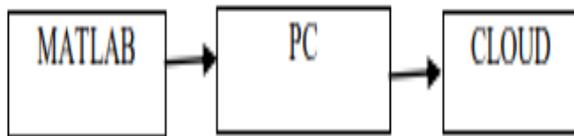
This project focuses on Plant massive and agriculture field with the parameters like soil, temperature, and status and actinic ray rays. The planned approach uses K-Means bunch Convolutional Neural Network and SVM classifiers, as a result of it provides high accuracy compared to multi-layer perceptrons (MLP). Constant observance can facilitate growers build selections and facilitate manage the causes of problems as opposition treating symptoms.



**Fig. 1. Block Diagram of IOT Based Smart Farming Receiver**

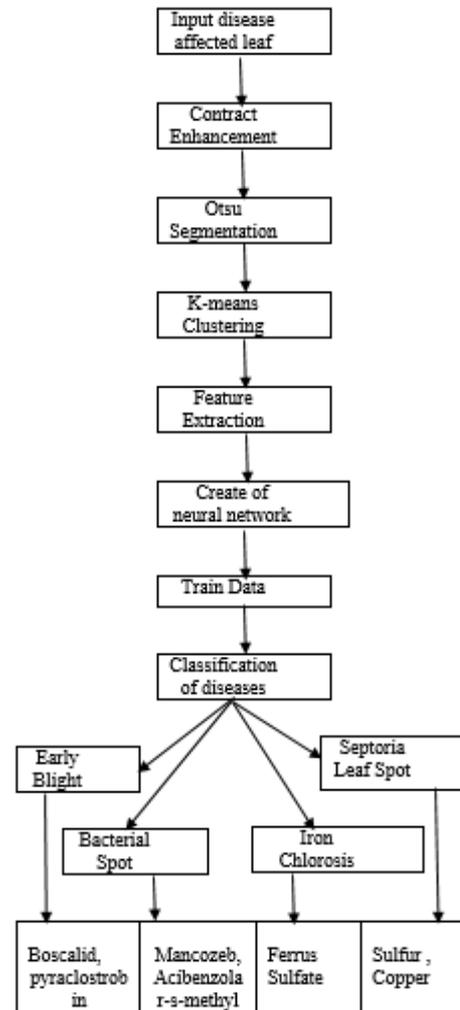
In the on top of diagram, we used four sensors, with many raspberry pi interconnected with Camera and cloud is shown [Fig. 1]. The sensors need to be connected to some points among the Raspberry Pi. Raspberry Pi consists of forty pins, during this some are GPIO pins, some are GND, some are IDEEPROM pins and some are few voltage pins. Input and Output devices could also be connected to the general Purpose Input.

In the above diagram, we are interconnected MATLAB with pc and Cloud is shown [Fig. 2].



**Fig. 2. Block Diagram of IOT Based Smart Farming Transmitter**

Segmentation manner partitioning of a picture into varied a region of the equal feature or having some similarity. The segmentation might even be dead exploitation Otsu’s technique, K approach clump, dynamic RGB to HSI model thus on. Feature extraction performs a vital role among the identity of associate object. In many utility of photograph method, characteristic extraction is used. The choices which might be utilized in plant grievance detection. “Support Vector Machine” (SVM) may be a supervised machine learning algorithmic rule it’s used for classification and regression challenges. However, it’s chiefly utilized in classification problems.



**Fig. 3. The proposed technology of a Block diagram for plant disease detection**

**C. TECHNIQUE OF SEGMENTATION AND FEATURE EXTRACTION:**

The following section describes varied segmentation and feature extraction techniques for detection of plant diseases. The segmentation supported K-means technique can be a partition bunch technique accustomed partition n vary of observations into k clusters .In this technique, k is that the range of clusters among the segmental image and colors gift in a very image unit used for the cluster. The most advantage of segmentation based K-means cluster technique is that it works on native information and world info of image. K-means cluster algorithmic rule is easy to implement and fast, durable and versatile. The flow design have several steps i.e. first, the infected plant image goes through the image pre-processing half for enhancing and removing noise from image. Second, the preprocessed image passed to the segmentation for partitioning into clusters. For segmentation K-means cluster technique is fast, versatile and easy to implement than others. From segmental image extracts the choices of image like color feature, type feature. Color feature is used to alter the item extraction and identification. For that numerous color models unit used like RGB.

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The feel feature may well be a feature that classifies the segmental regions and to boot defines the characteristics of regions. Form could be a feature that interprets varied facts of objects. Atlast classifier is used for classification and recognition of plant leaf disease detections.

## • CONVOLUTION NEURAL NETWORK:

Convolutional neural networks (CNN) are usually used for the creation of a method model that works on the unstructured image inputs and converts them to corresponding classification output labels. They belong to the category of multi-layer neural networks which can be trained to be told the desired choices for classification functions. They have less pre-processing as compared to ancient approaches and perform automatic feature extraction that provides higher performance.

CNN is employed permanently prediction of image in distinction of image segmentation, it results in a lot of tolerance to co-related inputs from user Suggestion.

## • SVM CLASSIFICATION

“Support Vector Machine” (SVM) could be a supervised machine learning it’s used to the classification and regression challenges. However, it’s chiefly utilized in classification problems. Support Vectors are just the co-ordinates of individual observation. Support Vector Machine could also be a frontier that best segregates the two classes.

SVM are often utilize prophetic power of linear mixtures of the inputs from user and provides sensible image productiveness in several things, and conjointly offer low generalization errors.

## • K-MEANS CLUSTERING

Image segmentation is that the methodology accustomed alter the illustration of an image into one factor that is extra pregnant and easier to analyses. K-means clump could also be a partitioning technique.

The ‘k-means’ partitions info into k reciprocally exclusive clusters, and returns the index of the cluster thereto it’s assigned each observation. In contrast to stratified clump, k-means clump operates on actual observations, and creates one level of clusters. The distinctions mean that k-means clump is sometimes extra applicable than stratified clump for large amounts of data. K-means treats each observation in your info as Associate in nursing object having a location in space. It finds a partition throughout that objects at intervals each cluster are as close to each other as come-at-able, and as aloof from objects in various clusters as potential. K-means offer best manner of image segmentation and may method terribly massive set of knowledge segments and leads a lot of efficient manner of image process.

## II. HARDWARE COMPONENTS

### A. Raspberry Pi3:

The raspberry Pi3 is also a basic model of third era Raspberry Pi. It’s supplanted by Raspberry Pi model2 in Feb 2016.

### B. DHT11 Sensor:

DHT11 detector is used to measure the environmental wetness and temperature. It have resistive elements and NTC temperature measure devices. DHT11 detector is high accountable and future stability.

### C. Soil wet sensor:

The soil wet detector is used to see the wet level inside the soil. If the soil has water shortage it offers output high otherwise low. By victimization this detector one can automatically water the vascular plant, or the opposite plants requiring automatic watering technique.

### D. UV sensor:

The actinic radiation detector is used to sense the 240-370nm vary of sunshine. It accustomed observe the intensity of the incident ultraviolet (UV) radiation like daylight. This type of non-particulate radiation has shorter wavelengths than light. The module outputs calibrate analog output voltage that varies with the actinic radiation intensity.

### E. LCD:

LCD show (Liquid Crystal Display) is associate electronic show. This could be accustomed show the data on the screen. It’s 16X2 alphanumeric display is associate electronic show. This could be usually aware of show the values on the screen. It’s a 16x2 alphanumeric display. This show operates in 8-bit and 4-bit mode.

### F. Web Cam:

Web cam is virtual camera that is associated with a laptop. It’ll send live pix from wherever it’s sited to a different region through the coordinated. Numerous work area data processor screens and PCs accompany a sophisticated camera and equipment, even so inside the event that yours doesn’t, you’ll embrace a singular camera whenever.

## III. SOFTWARE PACKAGE REQUIREMENTS

- MATLAB
- PYTHON

### Working of the project:

The operative of the project is simple. Throughout this project we observe the disease and observance and dominant the parameters. We tend to observe disease victimization digital image method. Here the environmental physical parameters mistreatment sensing components like DHT11 detector, soil wet sensor, PH sensor. These sensors collect the data and send this data to a raspberry PI. The operation and transfer it to the server. The pumping motor will rely on the soil condition if the soil is wet motor will automatically pack up otherwise it’s going to on.

IV. OUTPUT AND RESULTS

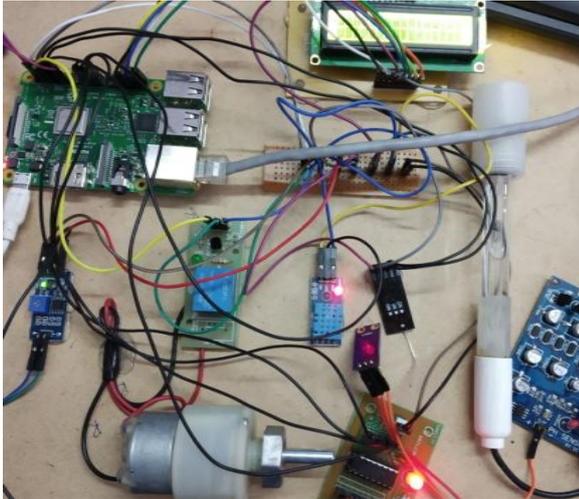


Fig. 4. Hardware arrangement of the project

The above figure represents the association of hardware parts for human action alternative devices to enhance the correct results through HW parts like sensors, raspberry pi, LCD etc.

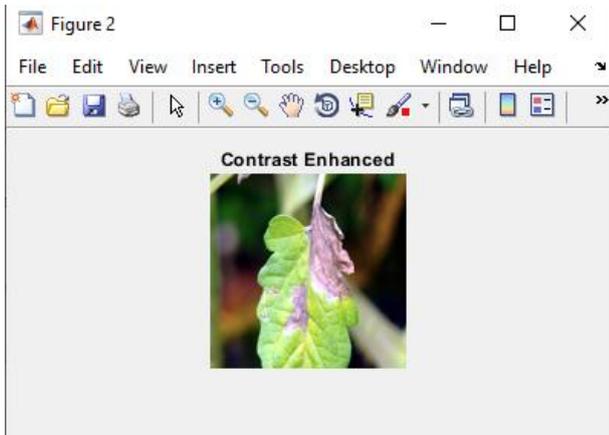


Fig. 5. A Contrast enhanced input image

The above figure represents the capturing input image. This image are often send to mail for furthur image method.

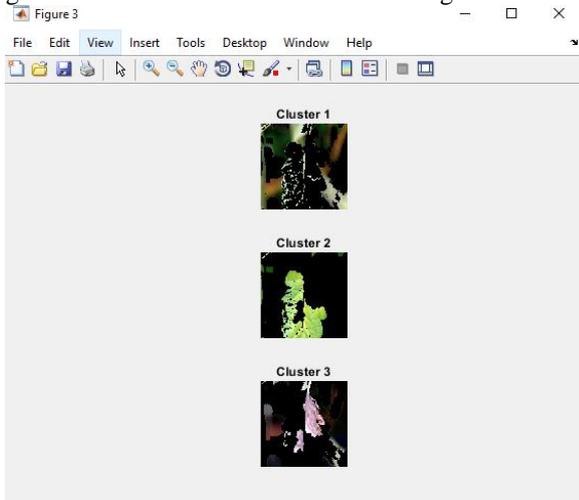


Fig. 6. K-means clustering of input image clustert 1 is medium and cluster 2 is low and cluster 3 is high segmented images

The above figure represents the when capturing input image. It will method and show method of three differnet color clusters it leads easy identification and provides choices for user selection for furthur method.

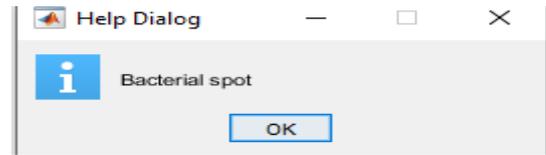


Fig. 7. Bacterial spot disease is detected in the above image

The above figure represents the malady name when cluster of image. we will provide method and discover the remedy for this unwellness.

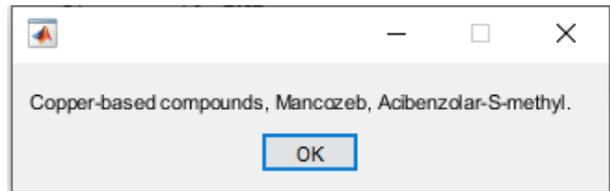


Fig. 8. Remide for protecting the leaves from the disease

The above figure represents the remedy of on top of disease. it's necessary for obtaining remedy, this manner we are able to get remedy for every disease identification supported user Input.

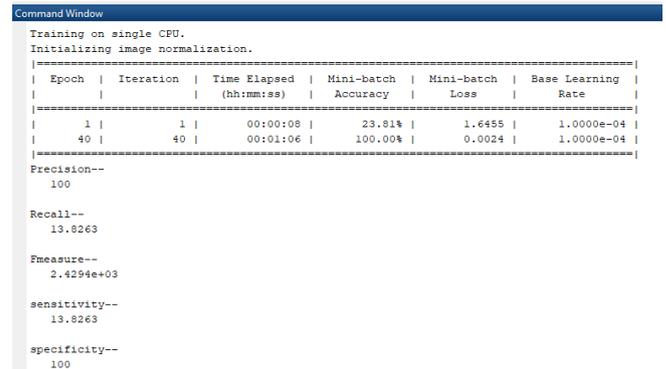


Fig. 9. performance metrics of proposed system

The above figure represents the Accuracy, sensitivity, specificity, Recall, prcetion and load time of matlab method along side Time. This values represents the development of quality compare to Existing Sytem.

V. CONCLUSION

This paper reviews and summarizes image method techniques that are used for distinguishing plant leaf diseases. The foremost techniques for detection of plant diseases are: Otsu segmentation, CNN, SVM & K-means algorithms. Among these CNN area unit simple to use with some parameters to control. It is applicable in wide range of problems inside the globe field.

These techniques square measure accustomed analyses the healthy and pathologic plants leaves.

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Variety of the challenges in these techniques viz. image improvement of the technique for a selected tomato leaf diseases, and automation of the technique for continuous automatic observance of plant leaf diseases below world field conditions. The review suggests that this malady detection technique shows a good potential and high accuracy & prediction with a capability of herb leaf diseases. The planned system accuracy is increasing 15% compared with existing system accuracy.



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## REFERENCES:

1. Tanmay Baranwal, Nitika, Pushpendra Kumar Pateriya, "Development of IOT primarily based good security and observation devices for agriculture" IEEE conference publication, 2016.
2. Krešimir Grgić, Ivan Špeh, Ivan Hedi," A web-based IoT resolution for observation knowledge victimisation MQTT Protocol" IEEE conference publication, 2016.
3. J.Dhivy, R.Siva Sundari, S.Sudha, R.Thenmozhi International Journal of Advanced analysis in Electrical, physical science and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) Vol. 5, Issue 4, April 2016.
4. Nurjaha Bagwan, Pradnya Kushire, Manasi Deshpande, Priyanka Singh, Prof. Shyam Gupta, "Efficient Water Saving Technique for inexperienced Farming victimisation IOT", International Journal of research project in technology, Engineering and data Technology © a pair of 017 IJSRCSEIT | Volume 2 | Issue half dozen | ISSN: 2456-3307.
5. Pranjali B. Padol, Prof. Anjali.Yadav, "SVM Classifier primarily based Grape plant disease Detection" 2016 Conference on Advances in Signal Processing(CAPS) Cummins school of Engineering for girls, Pune. June 9-11, 2016.
6. Tejoindhi M.R, Nanjesh B.R, JagadeeshGujanuru science, AshwinGeetD'sa "Plant malady Analysis victimisation bar chart Matching supported Bhattacharya's Distance Calculation" International Conference on Electrical, physical science and improvement Techniques(ICE OT)-2016
7. Tanvimehera, Vinay Kumar,pragyagupta "Maturity and disease detection in tomato victimisation pc vision" 2016 Fourth international conference on parallel, distributed and grid computing(PDGC)
8. Mukesh Kumar Tripathi, Dr.Dhananjay, D.Maktedar" Recent Machine Learning primarily based Approaches for disease Detection and Classification of Agricultural Products" International Conference on Electrical, physical science and improvement Techniques (ICE OT)-2016.
9. Murali Krishnan and Dr.M.G.Sumithra "A Novel Algorithm for Detecting Bacterial Leaf Scorch (BLS) of Shade Trees Using Image Processing" 2013 IEEE 11<sup>th</sup> Malaysia International Conference on Communications 26th - 28th November 2013, Kuala Lumpur, Malaysia pp. 978-1-4799-1532-3/13.
10. Ms. Kiran R. Gavhale, Prof. UjwallaGawande and Mr. Kamal O. Hajari "Unhealthy Region of Citrus Leaf Detection Using Image Processing Techniques" 2014 IEEE International Conference for Convergence of Technology, pp. 978-1-4799-3759- 2/14.
11. UsamaMokhtar, Mona A. S. Alit, Aboul Ella Hassenian, HeshamHefny "Tomato leaves diseases detection approach based on support vector machines" 2015 IEEE pp. 978-1-5090-0275-7/15.

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