

Plant Health Monitoring using IoT

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Abstract— In agribusiness exploration of programmed checking of diverse parameters alongside leaf malady recognition is imperative examination subject as it may demonstrate advantages in controlling substantial zone of yields, and subsequently this framework naturally identifies side effects of sickness when they show up on plant clears out. The term leaf infection is typically utilized just for devastation of live and sound takes off. This paper gives thought regarding estimation of diverse climatic parameters of plant and investigation of leaf sickness discovery utilizing picture handling and sends the whole data over web by method for term IoT. Internet of Things (IoT) expects to stretch out Internet to huge number of dispersed gadgets by characterizing standard, interoperable correspondence convention. The real goal of Internet of Things (IoT) is to make a keen situation utilizing empowering advances, for example, sensors, inserted gadgets, and correspondence conventions. For result reason grape plant is picked in certain framework. Creating Grape is an overwhelming errand as the plant is presented to the assaults from different small-scale life forms, bacterial maladies and irritations. The side effects of the assaults are generally recognized through the leaves, stems or organic product examination. That is the reason leaf ailment location of grape plant is picked in this framework.

Keywords — Internet of Things, controlling substantial zone of yields, diverse climatic, leaf sickness discovery.

I. INTRODUCTION

In India around 70% of the populace wins its employment from farming. Regardless it gives business to the general population in our nation. It satisfies the essential need of individuals and creatures. It is an imperative wellspring of crude material for some agro based businesses. India's geological condition is extraordinary for farming in light of the fact that it gives numerous good conditions. There are plain ranges, ripe soil, long developing season and wide variety in climatic condition and so forth. Aside from extraordinary geological conditions, India has been reliably using so as to try imaginative endeavors science and innovation to expand creation. Agribusiness has been one of the essential occupations of man subsequent to ahead of schedule civic establishments and even today manual intercessions in cultivating are inescapable. India is positioning second in homestead yield. Observing and controlling the horticulture is a critical assignment for the ranchers as they need to consistently give consideration on harvest development for better yield. In this manner proposed framework comprises the remote estimation and controlling of distinctive natural parameters of field over the web.

Image Processing is cast core research area within engineering and computer science regulation too. Image processing basically contains the following three steps:

- a) Importing the image with ocular scanner or by digital photography.
- b) Analyzing and handling the image which includes data condensation and image enhancement and spotting patterns that are not to human eyes like satellite photographs.

- c) Output is the last stage in which result can be changed image or report that is based on image analysis.

II. RELATED WORK OR LITERATURE SURVEY

A) Detection and classification of plant leaf Disease using image processing

techniques: a review

Authors : Savita N. Ghaiwat

Year : 2018

Findings

This paper describes an image processing technique that identifies the visual symptoms of chili plant Disease using an analysis of colored images, Work of software program that recognizes the color and shape of the chili leaf image, LABVIEW software was used to capture the image of chili plant in RGB color model and MATLAB software was used to enable a recognition process to determine the chili plant disease through the leaf images, the input image was enhanced to preserve information of the affected pixels before extracting chili leaf image from the background. The color model respectively was used to reduce effect of illumination and distinguish between chili and non-chili leaf color efficiently and the resulting color pixels are clustered to obtain groups of colors in the image is shown.

B) Agricultural plant leaf disease detection using image processing

Authors : Prof. Sanjay B

Year : 2019

Findings

In this paper introduce an innovative approach to automatically detect and grade the Disease on pomegranate fruit Module identification of this paper is Bacterial Blight, Cercospora fruit spot, Fruit Rot, Alternaria fruit Spot Disease on pomegranate fruit. Molecular techniques and profiling of plant volatile organic compounds were used for Disease detection its vital functions such as photosynthesis, transpiration, pollination, fertilization, germination, and some pomegranate fruit disease: Cercospora (Cercospora sp): The affected fruits showed small random black spots, which later on coalesce into big spots. Fruit Rot (Aspergillums foetidus): The symptoms were in the form of round black spots on the fruit and petiole. The disease starts from calyx end and gradually the entire fruit shows black spots, the fruit further rots emitting a foul odor. Bacterial Blight (Colletotrichum gloeosporioides): The disease was characterized by appearance of small, random and water-soaked spots on fruit. If cracks are passing through the spots then the disease identified would be Bacterial blight. Alternaria Fruit Spot (Alternaria alternata): Small reddish brown circular spots appeared on the fruits, as the disease advances these spots, blend to form larger patches and the fruits start crumbling, the arils get affected which become and become not suited for consumption.

C) An application of K-means clustering and artificial intelligence in pattern recognition for crop Disease

Authors: Mrunalini R.

Year : 2018

Findings

This paper connected to spectroscopic and imaging based, and volatile profiling based plant disease detection methods, Segmentation of leaf image is important while extracting the feature from that image, Methods of these spectroscopic and imaging techniques are: fluorescence imaging, multispectral or hyper spectral imaging, and infrared spectroscopy. The fluorescence steady at certain frequencies such as 450, 550, 690, and 740 nm and provide difference between the fluorescence at 550 and 690nm were higher in the diseased portion of the leaves, while it was very low for healthy regions of the leaves. Quadratic discriminant analysis (QDA) used for analysis, QDA classified healthy and diseased plants with an accuracy of 71% and 96%, respectively.

D) Classification of Plant Leaf Disease Using Machine Learning and Image Preprocessing Techniques

Authors : Pushkara Sharma, Pankaj Hans

Year : 2019

Findings

In this paper we are introducing the artificial intelligence based automatic plant leaf disease detection and classification for quick and easy detection of disease and then classifying it and performing required remedies to cure that disease. This approach of ours goals towards increasing the productivity of crops in agriculture. In this

approach we have follow several steps i.e. image collection, image preprocessing, segmentation and classification.

E) Plant Disease Detection Using Image Processing

Authors : Sachin D. Khirade; A.B. Patil

Year : 2019

Findings

In this paper we studies of the plant Disease mean the studies of visually observable patterns seen on the plant. Health monitoring and disease detection on plant is very critical for sustainable agriculture. It is very difficult to monitor the plant Disease manually. It requires tremendous amount of work, expertize in the plant Disease, and also require the excessive processing time. Hence, image processing is used for the detection of plant Disease. Disease detection involves the steps like image acquisition, image pre-processing, image segmentation, feature extraction and classification

Problem Domain:-Identification of diseases in the plant is most extreme requirement for farmers and agriculture specialists. The principle point of the proposed framework is to recognize plant diseases with the help of IoT (Internet of Things). In the greater part of the plants the sickness beginning happens on plant leaves. Subsequently, in the proposed work we have considered location of plant sickness present on leaves. The segregation of ordinary and influenced plant leaf can be estimated dependent on variety in temperature, dampness and shading.

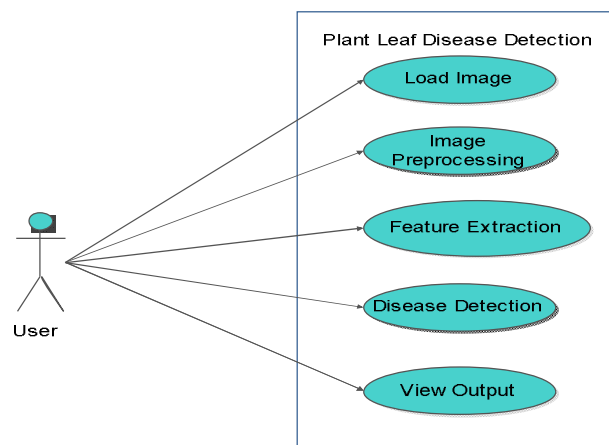
Problem Definition:-The main objective of the proposed system is to overcome the disadvantages of the existing system and build an accurate IoT system to detect the disease in the plant leaf.

Statement:-The purpose of this project is to build a system which could detect the Disease in the plants through the leaf image.

Innovative Content:-The technique evolved into the system is both image processing techniques and advance computing techniques. Image analysis can be applied for the following purposes:

1. To detect diseased leaf stem.
2. To quantify affected area by disease.
3. To find the boundaries of the affected area.
4. To determine the color of affected area.
5. To determine size and shape of leaf.
6. To identify the object correctly.

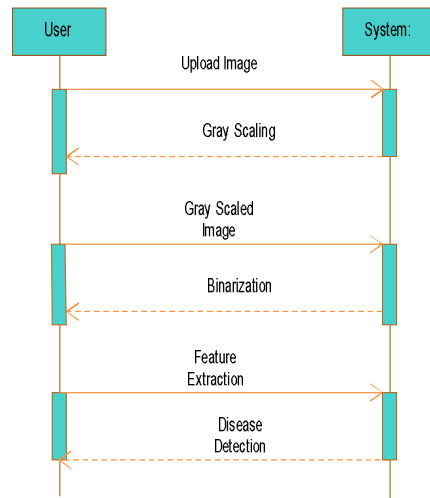
III. PROBLEM FORMULATION OR REPRESENTATION OR DESIGN



Above diagram represents the user use case diagram of the Plant Disease Detection. This diagram indicates the use cases or functionalities of program. Those activities are load image, image preprocessing, feature extraction, disease detection, view output.

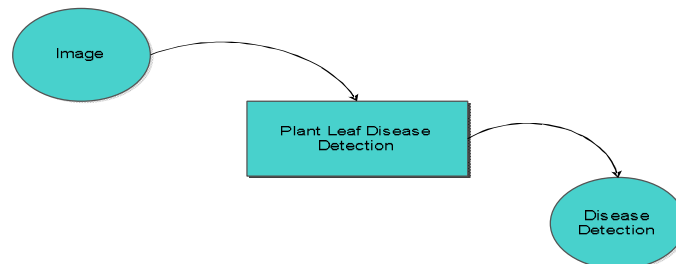
IV. SOLUTION METHODOLOGIES OR PROBLEM SOLVING

Above diagram represents the user sequence diagram of the Plant Leaf Disease Detection. This diagram indicates the flow of program. Initially user will load the image then that image will be converted to grayscale for faster processing, then the system will extract the feature from the image then based on the feature extracted it will classify the disease and give it as output to the system.



V. RESULTS AND SENSITIVITY ANALYSIS

A) Data Model



Above diagram represents the Level 0 DFD diagram of the Plant Leaf Disease Detection. This diagram indicates the process of program. Processes are represented in the form circle that are performed in the system, image will be given as input to the system and the output will be the disease detected.

B) Comparison of Results:

- Unit Testing
- Integration Testing
- Validation Testing
- System Testing
- Acceptance Testing

Unit Testing: Unit testing confirmation endeavors on the littlest unit of programming plan, module. This is known as "Module Testing". The modules are tried independently. This testing is done during the programming stage itself. In these testing steps, every module is discovered to be working acceptably with respect to the normal yield from the module.

Integration Testing:-Integration testing is a methodical strategy for developing tests to uncover blunders related with the interface. In the venture, every one of the modules is joined and afterward the whole developer is tried overall. In the combination testing step, the entire mistake revealed is amended for the following testing steps.

Validation Testing:-To uncover functional errors, that is, to check whether functional characteristics confirm to specification or not specified.

System Testing:-When individual module testing finished, modules are gathered to proceed as a framework. At that point, the hierarchical testing, which starts from the upper level to bring down level module testing, must be done to check whether the whole framework is performing acceptably.

After unit and integration testing are over then the system as whole is tested. There are two general strategies for system testing. They are:

- Code Testing
- Specification Testing

Code Testing:- This strategy examines the logic of the program. A path is a specific combination of conditions handled by the program. Using this strategy, every path through the program is tested.

Specification Testing:- This procedure analyzes the particulars expressing what the program ought to do and how it ought to perform under different conditions. The experiments are produced for each state of the created framework and prepared. It is tracked down that the framework created performs as per its predetermined necessities. The framework is utilized tentatively to guarantee that the product will run by its particular and in the manner the client anticipates. Particular Testing is done effectively by entering different sorts of end information. It is checked for both legitimate and invalid information and discovered the System is working appropriately according to necessity.

Acceptance Testing:-At the point when the framework has no action issue with its precision, the framework goes through a last acceptance test. This test affirms that the framework needs the first objective, Objective, and necessities set up during the investigation. On the off chance that the framework satisfies every one of the prerequisites, it is at last worthy and prepared for activity.

TEST PLAN

A product project test plan is an archive that depicts the destinations, scope approach, and focal point of a product testing exertion. This cycle of setting up a test plan is a valuable method to thoroughly consider the endeavors expected to approve the agreeableness of a product item. The finished report will help individuals outside the experimental group comprehend the 'Why and How' of creation approval. Diverse test plans are utilized at various degrees of testing.

TEST PLANS USED IN UNIT TESTING

Each module is tested for correctness whether it is meeting all the expected results. Condition loops in the code are properly terminated so that they don't enter into an infinite loop. Proper validations are done so as to avoid any errors related to data entry from user.

SYSTEM TESTING

System Testing alludes to the way of looking at a product program utility fundamentally dependent on what its particular says its conduct should be. In remarkable, we will develop check cases put together totally absolutely with respect to the detail of this current gadget's conduct, without seeing an execution of this framework.

Unit Test Cases

TABLE : UNIT TEST CASES

Test Case Number	Testing Scenario	Expected result	Result
TC – 01	Device is not connected	No data will be collected	Pass
TC – 02	Device is connected	Image will be captured	Pass
Uploading wrong data file	Alert” File extension not supported”		Pass

System Test Cases

TABLE : SYSTEM TEST CASES TABLE

Test Case Number	Testing Scenario	Expected result	Result
TC – 04	Uploading without choosing any file	Alert "Choose a file"	Pass
TC – 03	View grayscale image	Show correct grayscale image	Pass
TC – 04	View threshold image	Show correct threshold image of the leaf	Pass
TC – 05	View segmented image	Show correct segmented image of leaf	Pass
TC – 06	View Feature Extracted image	Show correct featured extracted image of leaf	Pass
TC – 07	View Output	Show correct disease name	Pass

VI. JUSTIFICATION OF THE RESULTS

Testing is the significant interaction engaged with programming quality assurance (QA). It is an iterative interaction. Here test information is arranged and is utilized to test the modules exclusively. Framework testing ensures that all segments of the framework work appropriately as a unit by really driving the framework to come up short.

The test causes ought to be arranged prior to testing starts. At that point as the testing advances, testing shifts center trying to discover blunders in incorporated groups of modules and in the whole framework. The way of thinking behind testing is to discover blunders. As a matter of fact, testing is the domain of execution that is pointed toward guaranteeing that the framework works really and proficiently before execution.

Testing is accomplished for every module. In the wake of testing every one of the modules, the modules are incorporated and testing of the last framework is finished with the test information, exceptionally intended to show that the framework will work effectively in the entirety of its viewpoints conditions. The methodology level testing is made first. By giving ill-advised data sources, the blunders that happened are noted and killed. Consequently, the framework testing is an affirmation that everything is right and a chance to show the client that the framework works. The last advance includes Validation testing, which decides if the product work as the client anticipated. The end-client instead of the framework designer leads this test by most programming engineers as a cycle called the "Alpha and Beta test" to uncover that solitary the end-client appears to be ready to discover.

This is the last advance in the framework life cycle. Here we carry out the tried blunder-free framework into a genuine climate and roll out vital improvements, which runs in an online design. Here framework upkeep is done each month or year dependent on organization approaches and is checked for blunders like runtime mistakes, since a long time ago run mistakes, and different systems of support like table confirmation and reports.

During the prerequisite examination and plan, the yield is a record that is typically text-based and non-executable. After the coding stage, PC programs are accessible that can be executed for testing purposes. This infers that testing not just needs to uncover blunders presented during coding, yet additionally mistakes presented during the past stages.

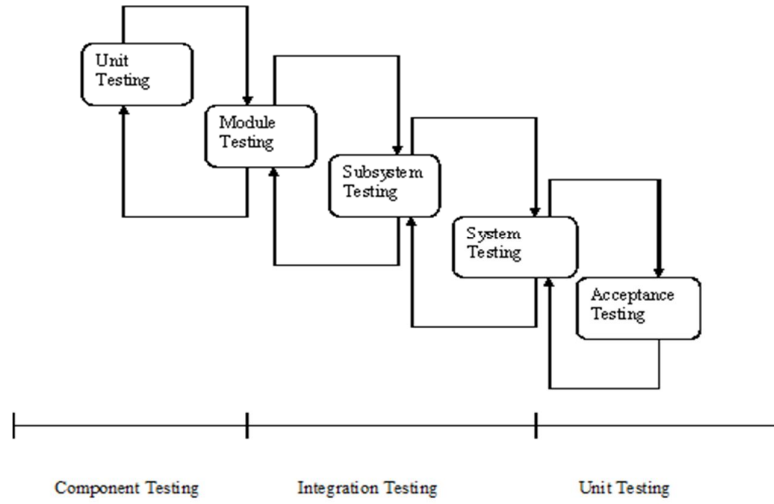
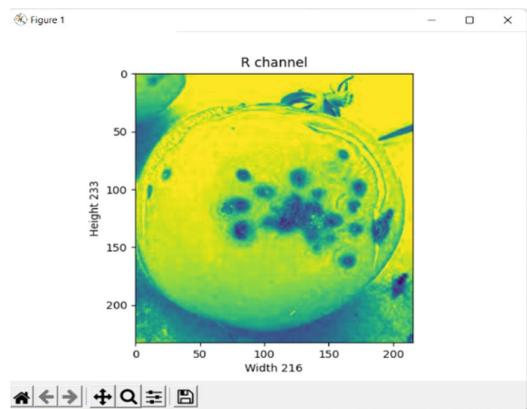
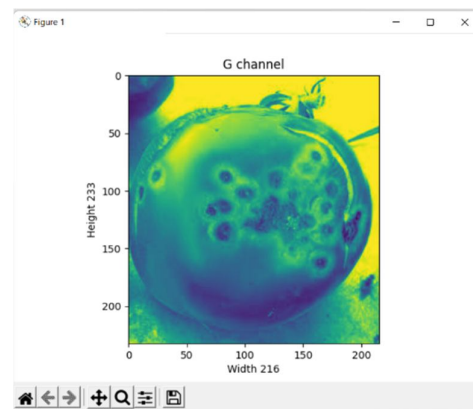


Fig. The Testing process

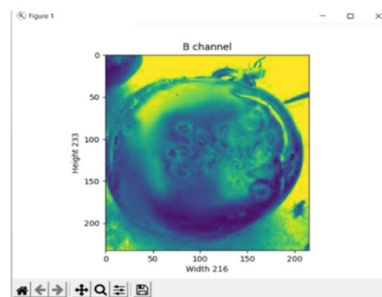
1.1 R channel



1.2 G channel



1.3 B channel



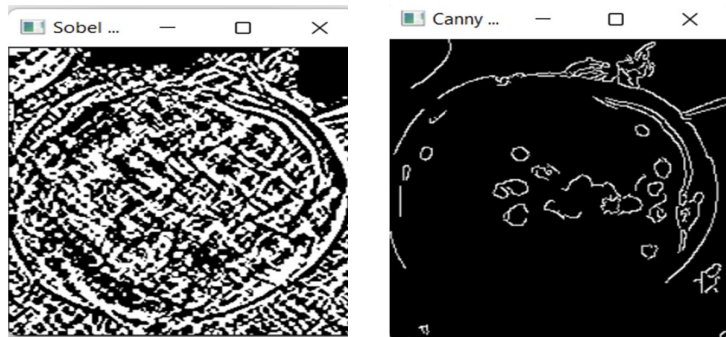
1.4 X axis



1.5 Y axis

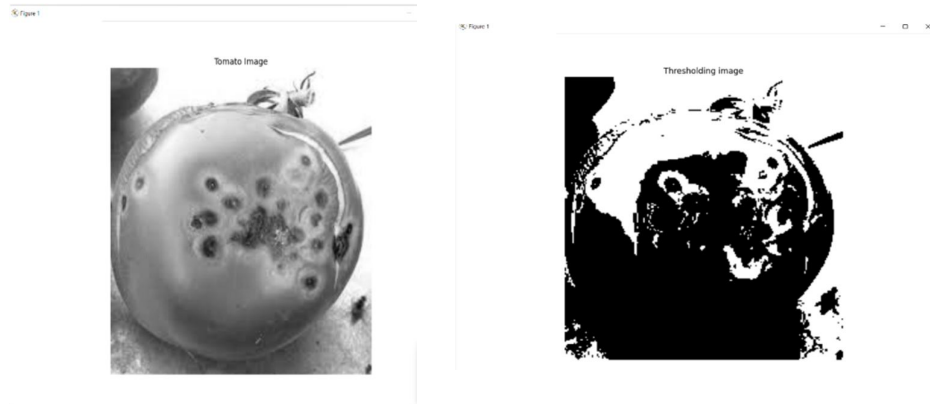


1.6 X AND Y AXIS

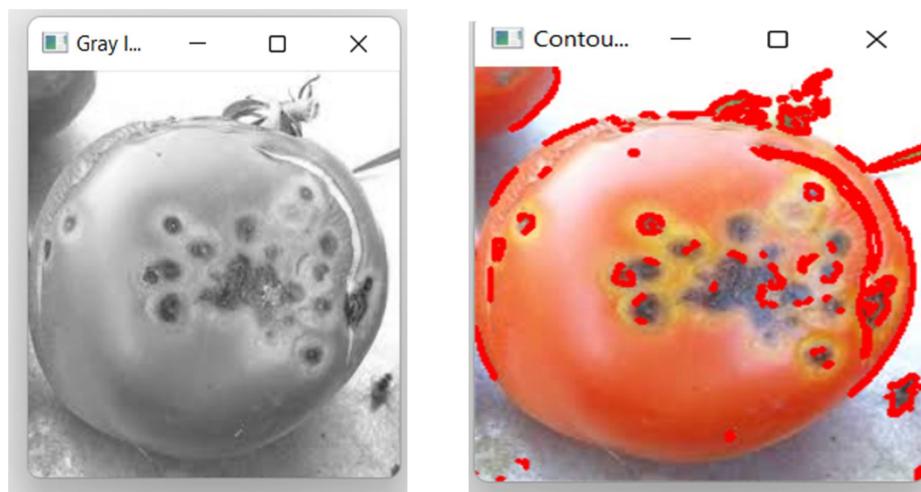


1.7 Tomato image

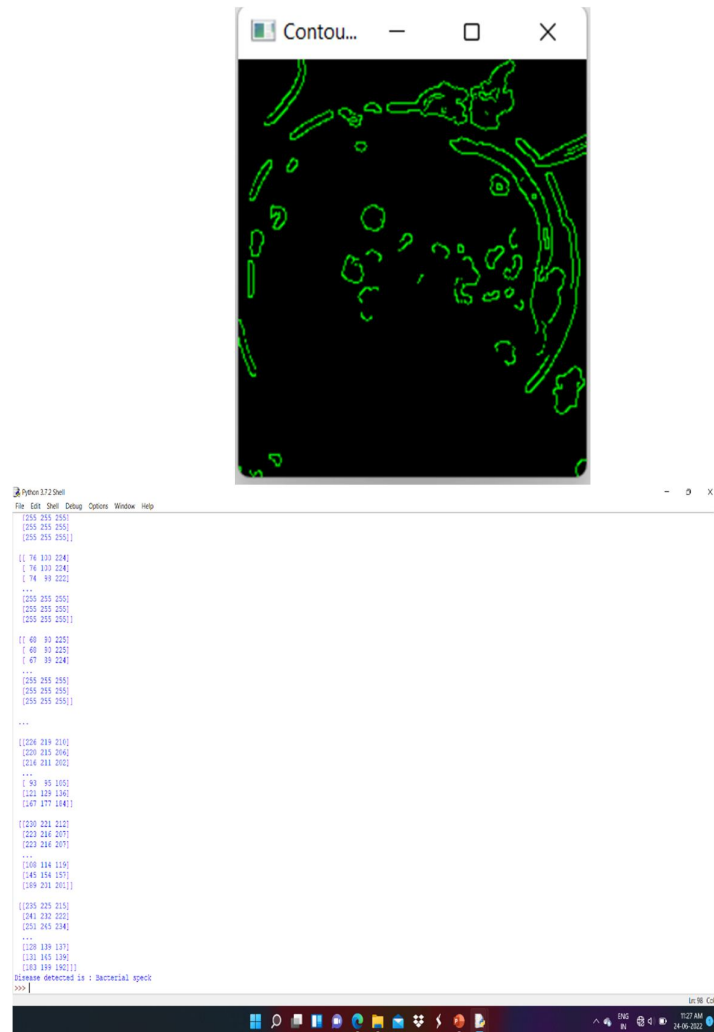
1.8 Thresholding image



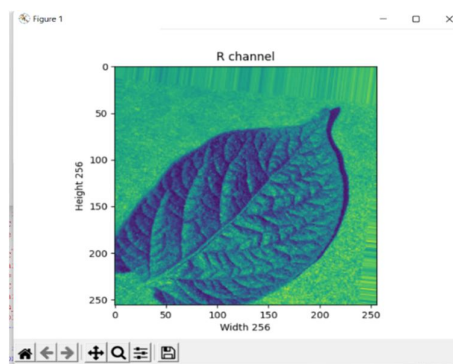
1.9 Gray scale



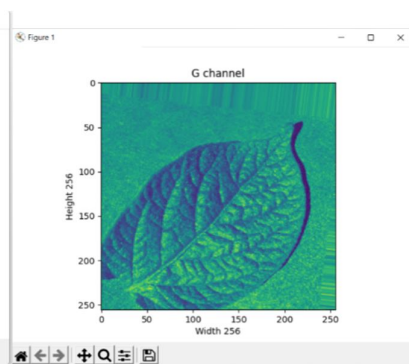
Result



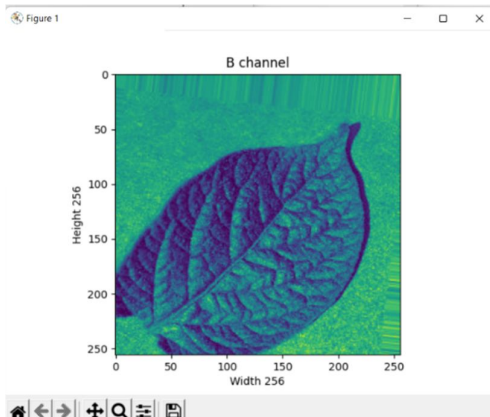
2.1 R Channel



2.2 G Channel



2.3 B channel



2.4 X axis



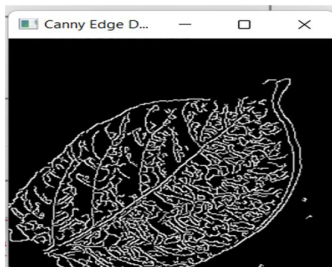
2.5 Y axis



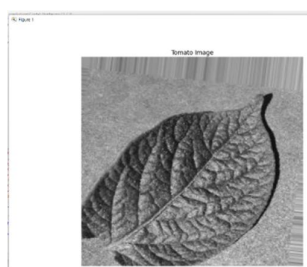
2.6 X AND Y axis



2.7 Leaf Image



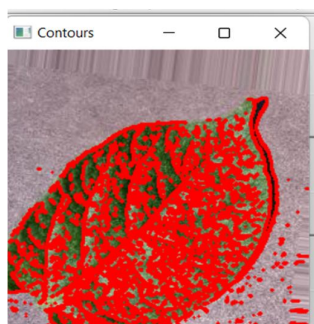
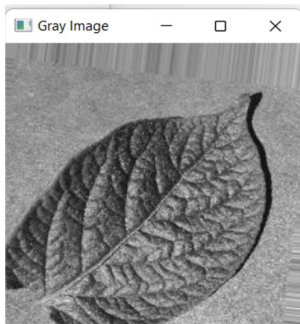
2.8 Thresholding



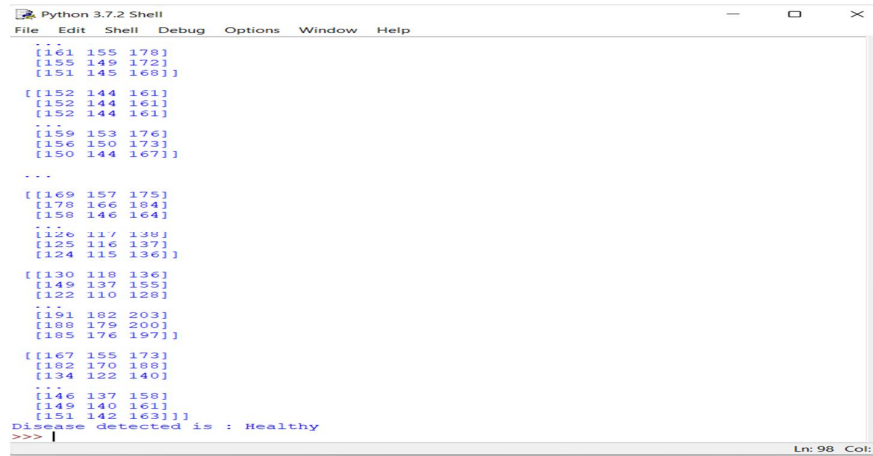
Image



2.9 Gray scale



Result



```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help

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[[151 155 178]]
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...
[[146 137 158]]
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[[151 142 163]]]]

Disease detected is : Healthy
>>>
```

VII. CONCLUSION

We have actualized a framework which indicates usage for Internet of Things utilized for observing general climatic parameters conditions by method for minimal effort, effectively accessible detecting framework. The depiction about the incorporated system building design and the interconnecting components for solid estimation of parameters by savvy sensors and transmission of information through web is being displayed in straightforward dialect. The objective of this proposed approach is to implement modern technologies of vision based with SVM model. Usage of Internet of Things system makes the process easier which is extended to some level of automation for capturing the images at regular intervals. The captured image is used further for applying vision-based technique for monitoring and analyzing the conditions of healthy and diseased leaf.

VIII. FUTURE WORK

In the future, more studies on the use of CNN and SVM can be done to observe the implications of their use, performance, and utility. System can be enhanced in the way that it can detect more number of diseases and the system accuracy and time can also be reduced more.

IX. ACKNOWLEDGEMENT

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