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IOT Enabled Weedicide Control Using Image Processing at Agriculture Field

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Abstract

The Aim of this project is to automate plant monitoring and smart gardening using IOT in the Arduino Mega Platform. Identifying diseases in plants leave is a challenging task for farmers and also for researchers. The key highlight of the project is able to detect the type of disease by use of image processing. Image Processing steps are pre-processing, spot segmentation and features extraction, and classification. The extracted features are optimized by genetic algorithm and classified by KNN Classifier. We proposed a methodology that is tested for four types of apple plant disease including healthy leaves, Black Rot, Rust, and Scab. When the disease is identified we provided a pesticide solution displayed in the LCD Display and the same is sent to the farmer mobile with the help of GSM. All the Stages are monitored in an IOT Webpage.

Keywords: IOT, Image Processing, Arduino Mega Platform, GSM, Smart farming.

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1. Introduction

Internet of Things (IoT) is the trending technology for smart farming to gain efficiency, productivity and resolve various issues present in the agriculture field. Internet of Things (IoT) network consists of various sensors that are used to monitor the soil acidity level, temperature, humidity and other variables. We used Arduino platform that is easy-to-use hardware and software. Internet of Things (IoT) gives a new look in the domain of smart farming and agriculture area. Farming and agriculture is the backbone of human life which gives food, grains, and other raw materials. Technology holds a huge role in increasing production and decreasing manpower [1]. IoT aims to combine the physical world with the virtual world with the help of Internet as the medium to communicate and exchange information [7]. Internet of Things (IoT) interconnects with sensors, actuators, and heterogeneous computing devices within the existing Internet infrastructure and the development environments [5]. In agriculture for irrigation we are using huge consumption of fresh water nearly 90% in the developed countries. The increased demand for water and the arising climate changes are anticipating that the water resources for agriculture will be lower in the upcoming decades [2]. The current challenges in agriculture field are pesticide management, crop monitoring and automated harvesting .Supplying the optimal treatments according to the orchard characteristics provides an efficient management of the crop or farms.[6] .The manual inspection of fruit diseases is a difficult process which can be minimized by using automated methods for detection of plant diseases at the earlier stage[8]..In the traditional farming that requires huge man power and there is no level of usage of fertilizer whereas in the automated farming it is more convenient than traditional farming.

2. Proposed Methodology

The Fig 1 shows the block diagram of the overall proposed work. In our project the main motive is automatic plant monitoring and identifying the plant disease and provide pesticide solution and all the stages of plant monitoring is updated in the IOT Module. For every plantation the major factor is soil pH level and climatic conditions. Here we monitoring about apple plantation, like other plants we started from the seeding. In traditional method either we collect seeds from the stores or extract the seeds from an apple fruit. Later on germinating the seeds by irrigation i.e. imbibitions followed by respiration, effect of light on seed germination, mobilization and development of the embryo. After that plant is transplanted to larger area to grow before that some essential measures should be taken such as sunlight, soil, space. The best pH level for apple tree is 5.0 - 7.0.After the tree sheds with green leaves the major problem arises is apple disease. Disease identification and providing solution to it is a challenging task.

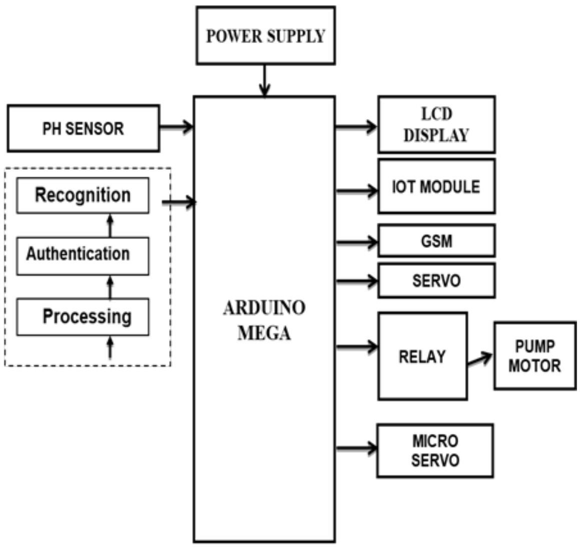


Figure 1. Block Diagram of overall proposed work

We proposed a methodology for automatic plant monitoring and disease identification and pesticide solution for apple plant disease. We have taken three types of apple plant disease black rot, apple scab, apple rust .Like every plantation we started from seeding the land using servo motor .The figure 2 is the servo motor. The servo motor is a small device with an output shaft and the shaft can be positioned to specific angle with a help of coded signal by the servo. The servo motor can rotate approximately 180 degrees i.e. 90 degree in each direction.

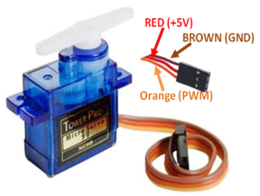


Figure 2. Servo Motor

After the servo motor does the seeding then pump motor start the work for irrigation mostly apple plant grow in hill areas so initial stage only requires more water than the upcoming stages .The figure 3 is the pump motor. The pump required huge power so we used relay for the power supply. A pump motor is a direct current motor device that moves fluids. It works under the principal of motoring action.

Figure 3. Pump Motor

The figure 3 is the pH sensor. The best pH range for apple plant is 5.0-7.0 is acidic in nature if it is 7.0 < then the soil is alkaline. If the soil is alkaline the micro servo motor starts for fertilizer. The micro servo motor performs the same operation as servo motor.

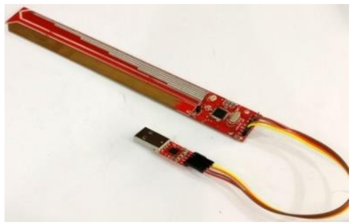


Figure 4. pH Sensor

The pH level now is checked after the fertilizer and if it is acidic then the step is the image processing for disease identification .We have taken three apple leaf disease black rot, apple scab, apple rust compared with an healthy leaf. We used machine learning algorithm .The Figure 5 shows the snapshots of leaf disease from initial original leaf is the input followed by four steps preprocessing, Segmentation, Feature Extraction, Classification.

Preprocessing: Preprocessing is the basic level of abstractions that eliminates the unwanted distortions or enhances some image features for future processing. Mostly the preprocessing are similar such as the neighboring pixels of the one object in the original image or the brightness value may be similar so distorted pixel as stored as a mean value of neighboring pixel. For preprocessing technique the original input image is resized and converted into gray scale image using the filters. After that we used 3D box filtering, de-correlation, 3D-Gaussian filter, and 3D-Median filter for the better vision of the disease spots in the input image.

Segmentation: Image Segmentation is a common technique used in digital image processing and analysis to divide an image into multiple parts of regions based on the characteristics of the pixels in the image..

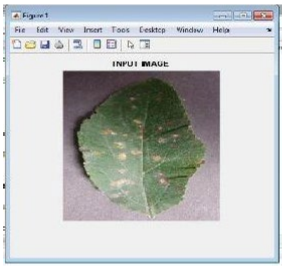
Feature Extraction: The feature extraction starts from an initial data set and get extracted and refrained to non-redundant data. The resultant set of data is the feature vector. Some of the feature extractions are shape features, color features, geometrical features, texture features. Shape Features are called as visual feature ex: shape of the image

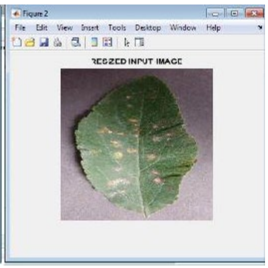
Such as triangular, circular or some other shapes. Color Features are local feature of the image such as color, texture, segmented regions Geometrical features are geometric features like points, curves, lines corner and edge features. We used three feature extraction methods such as GLCM (Grey level co-occurrence matrix), LBP (Local Binary Pattern), Region Segmentation and Genetic Algorithm. GLCM gives the texture features of the test image like contrast, correlation, energy and etc. Then the LBP gives the various different shape features of the input image. After that we used genetic algorithm for best feature selection in order to classify the different leaf diseases.

Classification: For classification we used KNN (k-Nearest Neighbour) algorithm. For every leaf disease the affected spot will be different .We used a data set for different leaf images and the spots are valued .Euclidean distance is used for distance metric.

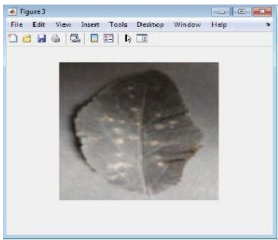
APPLE RUST

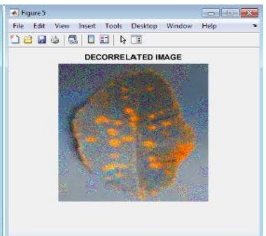
1. Input Image 2.Resized Image



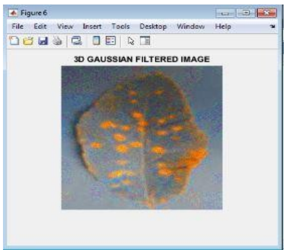


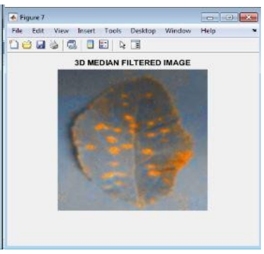
3.3d-Box Filtered Image 4.Decorrelated Image



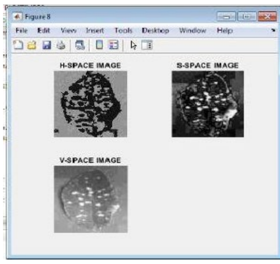


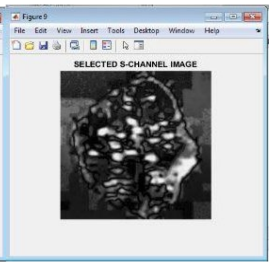
5.3D-Gaussian Filtered Image 6.3D-Median Filtered Image



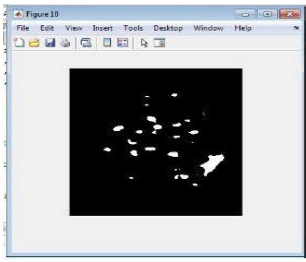


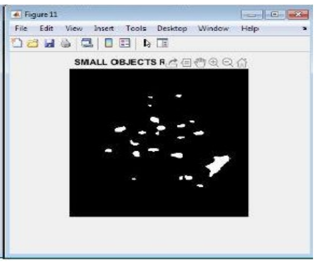
7. HSI Colour Space 8.S-Channel Image



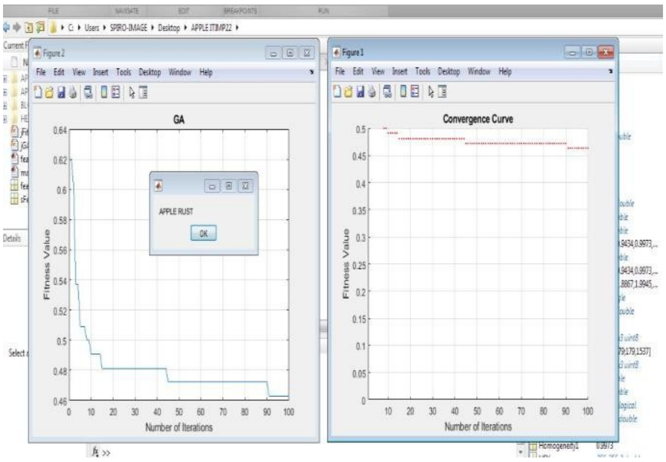


9. Black And White Image 10.Small Object Removed Image



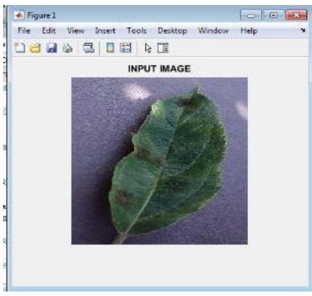


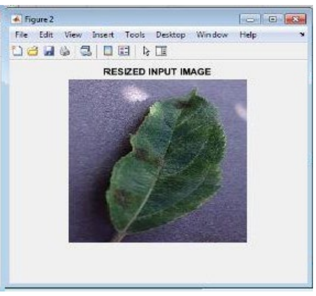
Final Output Image:



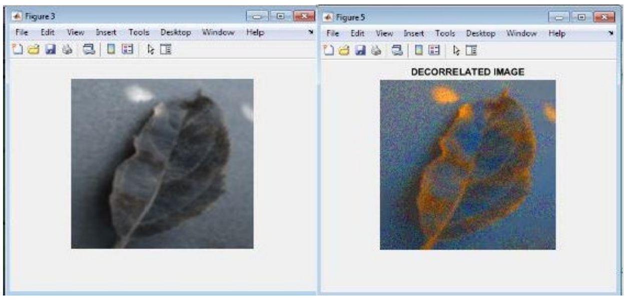
APPLE SCAB

1 .Input Image 2.Resized Image

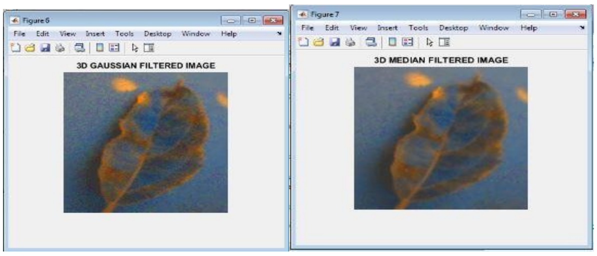




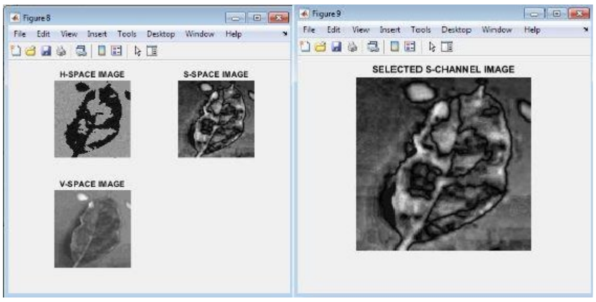
3.3D-Boxfiltered Image 4.Decorrelated Image



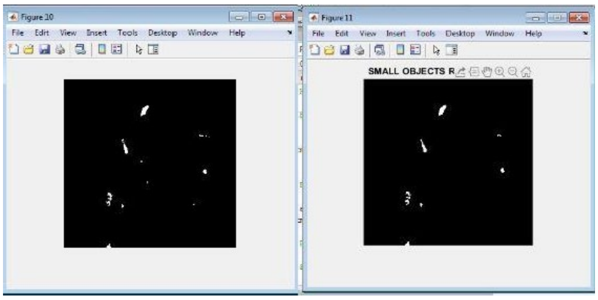
5. 3D-Gaussian Filtered Image 6. 3D-Median Filtered Image



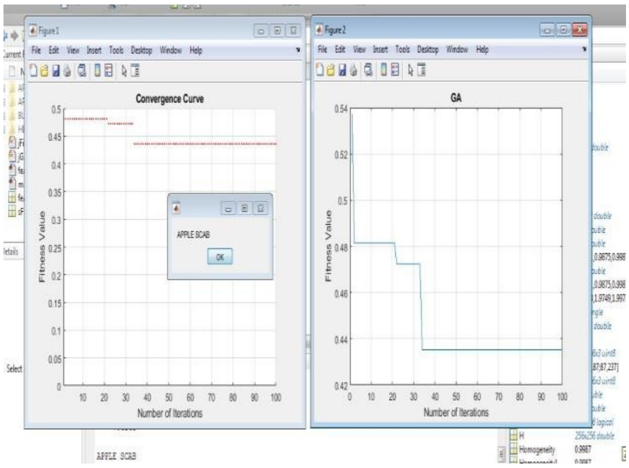
7. HSI -Colour Space 8.S-Channel Image



9. Black And White Image 10. Small Objects Removed Image

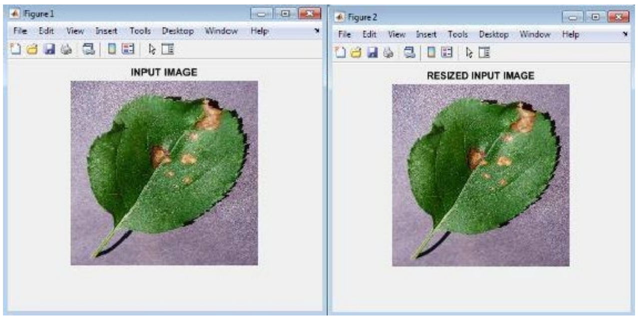


Final Output Image:

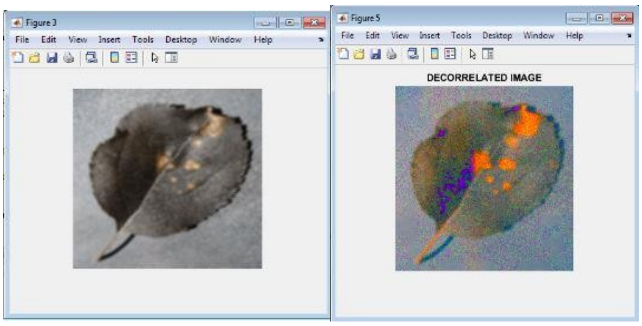


BLACK ROT:

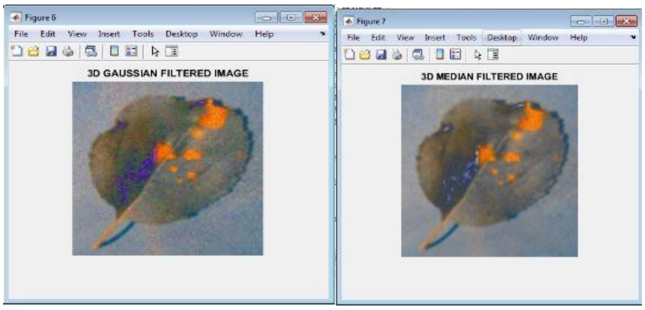
1. Input Image 2. Resized Image



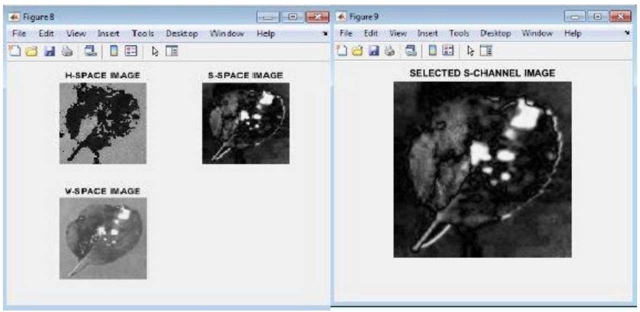
3. 3D-Box Filtered Image 4.Decorrelated Image



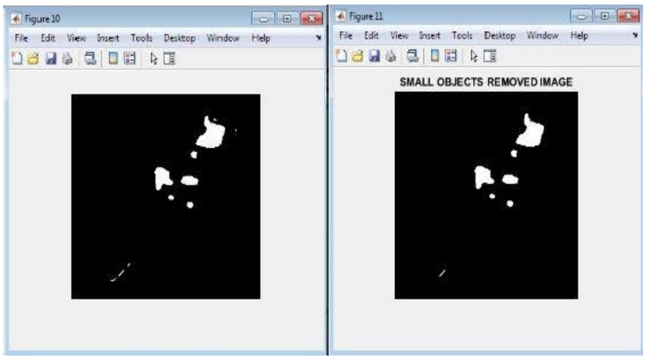
5. 3D-Gaussian Filtered Image 6.3D-Median Filtered Image



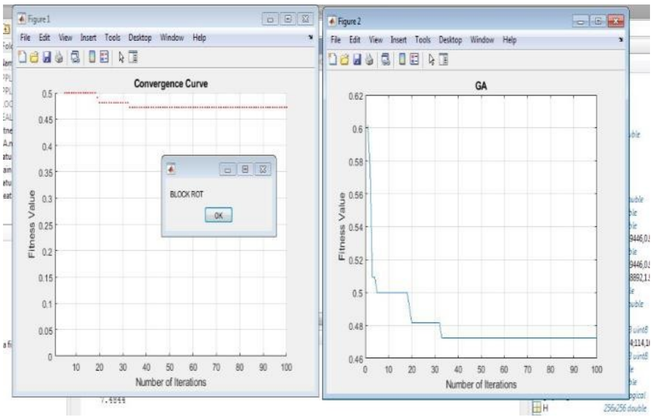
7. HSI-Colour Space 8.Selected S-Channel



9. Black And White Image 10.Small Object Removed Image

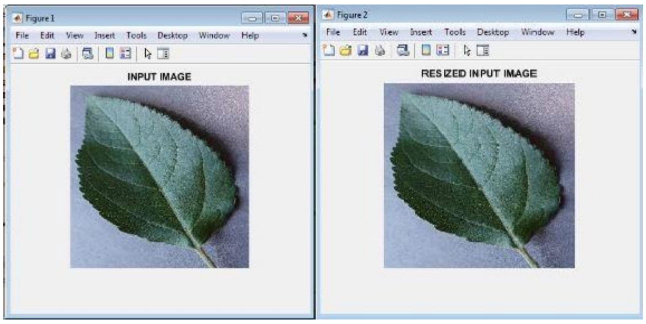


Final Output Image:

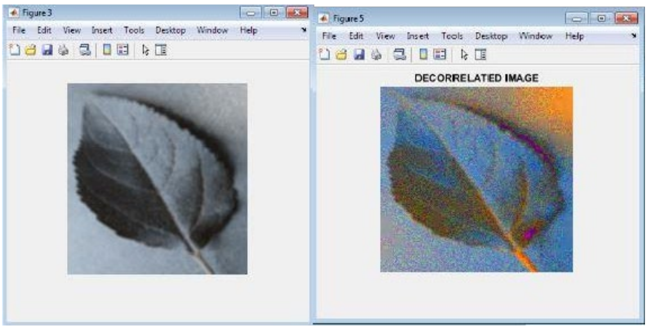


HEALTHY

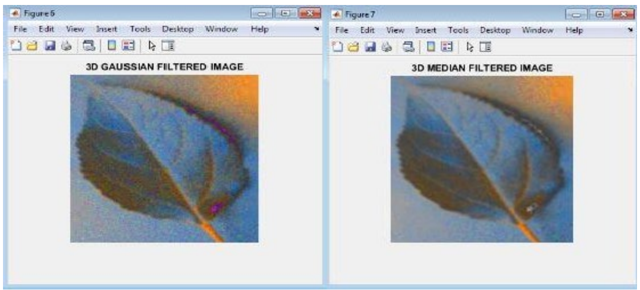
1. Input Image 2.Resized Image



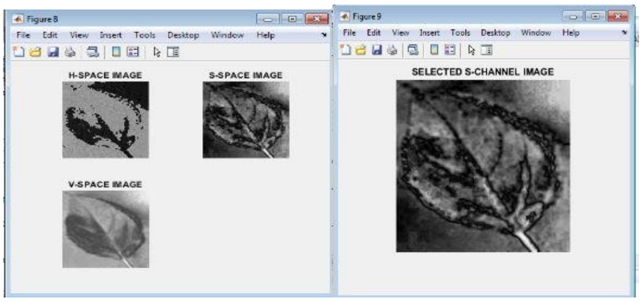
3.3D-Box Filtered Image 4.Decorrelated Image



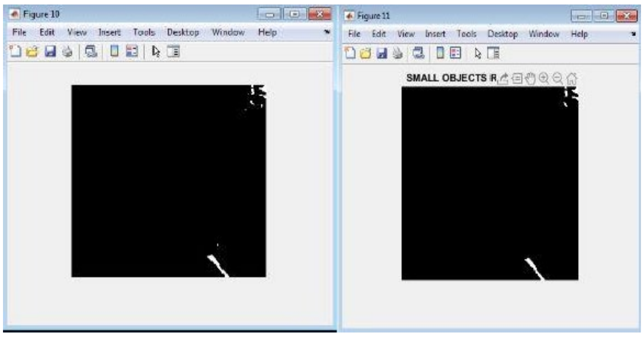
5. 3D-Gaussian Filtered Image 6. 3D-Median Filtered Image



7. HSI Colour Space 8.S-Channel Image



9. Black And White Image 10.Small Objects Remove Image



Final Output Image:

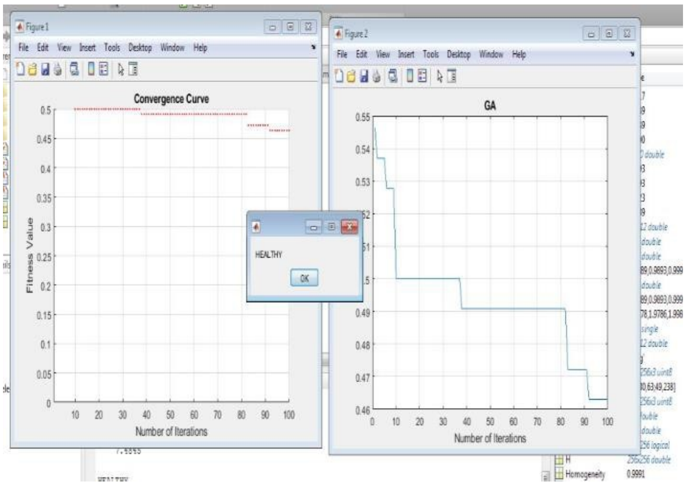
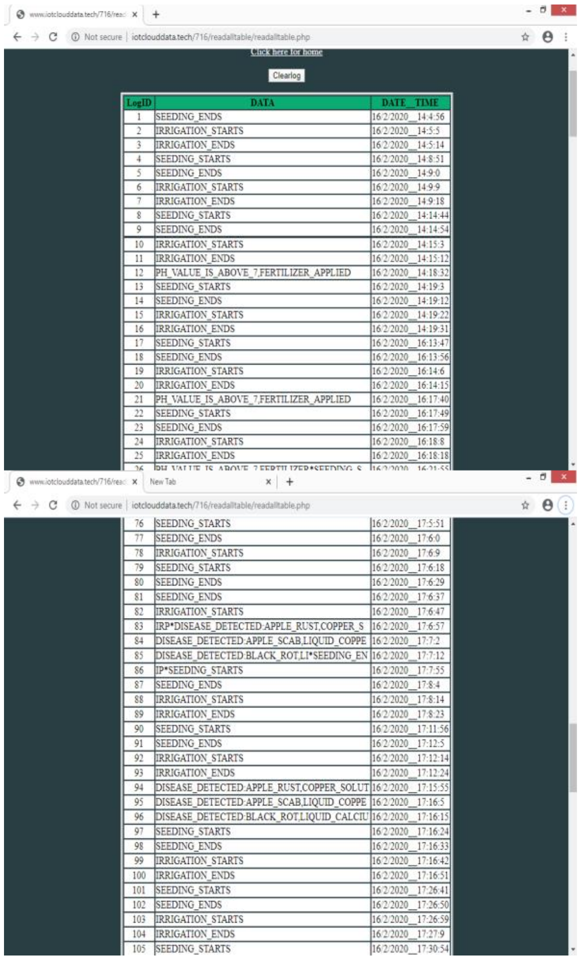


Figure 5. Snapshots of leaf disease identification from input image to final output image

The figure 5 shows the overall process of all leaf disease identification from input image to final outputs are elaborated in the snapshots. After the disease identification, now the disease is displayed in the LCD display with pesticide solution and the same message is sent to the farmer Mobile with the help of GSM. Now the farmer loads the pesticide solution and then the micro servo starts to spray the solution. The overall processes from seeding to pesticide stage are enrolled in the IOT Module. The Figure 6 shows the Webpage that stores the overall stages.



LogID	DATA	DATE__TIME
1	SEEDING_ENDS	16/2/2020__14:4:56
2	IRRIGATION_STARTS	16/2/2020__14:5:5
3	IRRIGATION_ENDS	16/2/2020__14:5:14
4	SEEDING_STARTS	16/2/2020__14:8:51
5	SEEDING_ENDS	16/2/2020__14:9:0
6	IRRIGATION_STARTS	16/2/2020__14:9:9
7	IRRIGATION_ENDS	16/2/2020__14:9:18
8	SEEDING_STARTS	16/2/2020__14:14:44
9	SEEDING_ENDS	16/2/2020__14:14:54
10	IRRIGATION_STARTS	16/2/2020__14:15:3
11	IRRIGATION_ENDS	16/2/2020__14:15:12
12	PH_VALUE_IS_ABOVE_7,FERTILIZER_APPLIED	16/2/2020__14:18:32
13	SEEDING_STARTS	16/2/2020__14:19:3
14	SEEDING_ENDS	16/2/2020__14:19:12
15	IRRIGATION_STARTS	16/2/2020__14:19:22
16	IRRIGATION_ENDS	16/2/2020__14:19:31
17	SEEDING_STARTS	16/2/2020__16:13:47
18	SEEDING_ENDS	16/2/2020__16:13:56
19	IRRIGATION_STARTS	16/2/2020__16:14:6
20	IRRIGATION_ENDS	16/2/2020__16:14:15
21	PH_VALUE_IS_ABOVE_7,FERTILIZER_APPLIED	16/2/2020__16:17:40
22	SEEDING_STARTS	16/2/2020__16:17:49
23	SEEDING_ENDS	16/2/2020__16:17:59
24	IRRIGATION_STARTS	16/2/2020__16:18:8
25	IRRIGATION_ENDS	16/2/2020__16:18:18
76	SEEDING_STARTS	16/2/2020__17:5:51
77	SEEDING_ENDS	16/2/2020__17:6:0
78	IRRIGATION_STARTS	16/2/2020__17:6:9
79	SEEDING_STARTS	16/2/2020__17:6:18
80	SEEDING_ENDS	16/2/2020__17:6:29
81	SEEDING_ENDS	16/2/2020__17:6:37
82	IRRIGATION_STARTS	16/2/2020__17:6:47
83	IRP*DISEASE_DETECTED:APPLE_RUST,COPPER_S	16/2/2020__17:6:57
84	DISEASE_DETECTED:APPLE_SCAB,LIQUID_COPPE	16/2/2020__17:7:2
85	DISEASE_DETECTED:BLACK_ROT,LI*SEEDING_EN	16/2/2020__17:7:12
86	IP*SEEDING_STARTS	16/2/2020__17:7:55
87	SEEDING_ENDS	16/2/2020__17:8:4
88	IRRIGATION_STARTS	16/2/2020__17:8:14
89	IRRIGATION_ENDS	16/2/2020__17:8:23
90	SEEDING_STARTS	16/2/2020__17:11:56
91	SEEDING_ENDS	16/2/2020__17:12:5
92	IRRIGATION_STARTS	16/2/2020__17:12:14
93	IRRIGATION_ENDS	16/2/2020__17:12:24
94	DISEASE_DETECTED:APPLE_RUST,COPPER_SOLUT	16/2/2020__17:15:55
95	DISEASE_DETECTED:APPLE_SCAB,LIQUID_COPPE	16/2/2020__17:16:5
96	DISEASE_DETECTED:BLACK_ROT,LIQUID_CALCIU	16/2/2020__17:16:15
97	SEEDING_STARTS	16/2/2020__17:16:24
98	SEEDING_ENDS	16/2/2020__17:16:33
99	IRRIGATION_STARTS	16/2/2020__17:16:42
100	IRRIGATION_ENDS	16/2/2020__17:16:51
101	SEEDING_STARTS	16/2/2020__17:26:41
102	SEEDING_ENDS	16/2/2020__17:26:50
103	IRRIGATION_STARTS	16/2/2020__17:26:59
104	IRRIGATION_ENDS	16/2/2020__17:27:9
105	SEEDING_STARTS	16/2/2020__17:30:54

Figure 6. Snapshots of IOT Webpage

3. Conclusion

IOT is an emerging technology and we proposed a methodology for smart farming with the use IOT components. The world population increases day by day so apart from traditional farming methods here we proposed automated farming techniques in apple plantation and the major problem arises in every plantation is disease identification .we have taken three major apple plant disease and provided solution for it. Smart communication between the farmer and the field by GSM and the IOT Webpage are also achieved.

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