TOMATO PLANT LEAF DISEASE DETECTION USING K-MEANS AND SVM CLASSIFIER

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Abstract: ***Agriculture is the major sector in India. About 58% of the rural livelihood influenced by in agriculture. Out of which tomato is one of the common food crops in India. Due to which detection of disease on tomato plant becomes important because less susceptibility. The plants productivity gets affected if proper care is not taken. Image processing is one of upbringing technology which is helping to resolve such issues with various algorithms and techniques. Most of the diseases of tomato plant detected at initial stages as they affects leaves first. By detecting the diseases at initial stage on leaves will surely avoid impending loss. In this project four key diseases are identified using image segmentation,convolutional neural networks and Multi-class Support Vector Machine (SVM) algorithm. For parting of damaged area on leaves image segmentation is used and for classification of accurate disease Multi-class SVM algorithm is used. In last stage symptoms and treatment to detected diseases recommended user. Automatic leaf disease detection is the very important research topic in agriculture field as it may prove benefits in monitoring and controlling large fields of crops and thus automatically detect diseases as soon as they appear on plant leaves. For excellent use of pesticide and to minimize the economical loss, the identification of disease severity is main factor. The disease is usually used for destruction of live plants. This project provide description of leaf disease detection using image processing that can recognize problems in crops from images, based on colour, texture and shape to automatically detect diseases and give the fast and accurate solutions to the farmer. The methods studies are for improve throughput and it will reduce subjectiveness which is arising from human experts in detecting the leaf disease. Digital image processing is a main technique which is used for Enhancement of the image. To upgrade agricultural products automatic detection of disease symptoms is beneficial. The design and implementation of Otsu segmentation technologies are totally automatic and it will greatly aid in selective chemical application, reducing costs and thus leading to increased productivity, as well as improved produce. In the context of Smart farming, I address the challenge of integrating Internet of Things with Raspberry pi and sensors with image processing to improve the efficiency of the agriculture.***

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Index Terms**:** ***IOT, Green House, Raspberry Pi, Soil moisture, UV Sensor, Humidity Sensor, K-means, SVM and CNN classifier.***

1. INTRODUCTION

A Country's economic system improvement relies upon on the rural land mass and productiveness. Majority of the population are depended on, agriculture. Farmers domesticate various flowers based at the soil fertility and availability of sources. Due to modifications inside the environmental conditions inclusive of rainfall, temperature soil fertility, the plants can get inflamed with the aid of the use of fungi, microorganism and viruses. They use appropriate pesticides and herbicides for the plant life for plant disease and growing the productiveness and high-quality of the product. Visual statement patterns at the crop are used for identifying and analyzing the plant sicknesses. Detection of plant disease on the preliminary diploma might be beneficial because the disease can be controlled. In few international locations, the will become don't have any concept or facility for contacting the professionals. A sampling approach for detection is visible observation of the leaf patterns via professionals. But it requires a big professional team. In such scenario an automatic plant infection or disease monitoring tool can be very beneficial. By comparing the plants infection/disease within the agricultural farmland with the stored plant disorder signs with the aid of using automation can be less high-priced. Here we classify the plant disease into 3 specifically Anthracnose, Cercospora Leaf Spot and Bacterial Blight. Anthracnose motives spot shaped spots at the leaf with tan or brown color. These blotches can be close to leaf veins. Severe infection will result in the leaf drop. Cercospora leaf spot leaf will be having small, brown flecks with a reddish border. It spreads out with a gray center. Later financial the leaf tissue will become skinny and brittle and drops out leaving a hollow. Bacterial Blight disease can have an impact on trunk, branches, shoots, buds, flora, leaves and fruit of a plant. Mild green spots are at the leaf and it spread over the leaf.

Sensors are key components of Firm monitoring system. Each sensor continually measures a specific condition like temperature or humidity in a specific location and reports those measurements to the system. Each sensor is connected to one of the base unit's input terminal strips. Because each condition requires its own input, you have to match your needs with the number of inputs available.

DHT11 Temperature and Humidity Sensor feature a calibrated output with the temperature and humidity sensor capability. It is integrated with a high-performance Raspberry Pi Microcontroller. Its technology ensures the high reliability and excellent long-term stability. Bacterial spot pathogens, disease can occur at different temperatures and is a threat to tomato production worldwide. Disease development is favored by temperatures of 75 to 86 °F and high precipitation.

Soil moisture sensors typically refer to sensors that estimate volumetric water content. Another class of sensors measure another property of moisture in soils called water potential. Measuring soil moisture is important for agricultural applications to help farmers manage their irrigation systems more efficiently. It is one of the most destructive diseases of tomato foliage and is particularly severe in areas where wet, humid weather persists for extended periods. These sensors are used to identify Septoria Leaf Spot in the plant.

Soil pH is a key parameter for crop productivity therefore its spatial variation should be adequately addressed to improve precision agriculture management system. Soil pH affects the soil's physical, chemical, and biological properties and processes, and thus plant growth. This sensor limiting the availability of iron to the plant is excess of heavy metals in the soil. These sensors are used to identify Iron Chlirosis in the plant.

UV Sensor is used for detecting the intensity of incident ultraviolet (UV) radiation. This form of electromagnetic radiation has shorter wavelengths than visible radiation. The Grove - UV Sensor is based on the sensor GUVA-S12D which has a wide spectral range of 200nm-400nm. This sensor plays a major role in identifying the plant growth.

In India, There is a tremendous variance of plant life that farmers possess. The historic and ionic get right of entry to for detection and popularity of plant disease is depending on naked eye statement, it truly is a little by little method also offers less certainty. In India, Especially in provincial areas consulting experts located that plant disease is highly-priced and time-ingesting because of the provision of professionals. A big wide variety of experts in addition to non-stop monitoring of experts are compulsory, which charges a large quantity whilst farms are enormous. Also, vain use of pesticides might be risky for natural sources inclusive of water, soil, air, meals chain and so forth.Automatic detection of plant diseases is important to discover the signs and symptoms of diseases in early levels. The crucial identity of the affected plant or crop is its leaves.

One general disorder is brown and yellow spots or early and past due scorch, and one of a kind are fungal, viral and bacterial disease. Image processing is the technique which makes use of laptop set of rules to create a gadget, communicate and display virtual pictures. It is used for measuring the damaged location of disease, and to determine the distinction inside the coloration of the affected region. In this project I am using the following techniques for automated plant disease detection after obtaining the picture from the virtual digital camera the image is pre-processed to growth or lower the contrast as a result and enhancement of the photograph to lessen noise.

The technique of preserving aside or grouping a photograph into awesome components is called Image Segmentation. Image segmentation is the technique of partitioning or grouping an image into exceptional factors. Features are extracted in advance than making use of SVM set of rules for category and detection, apparently there are special styles of techniques together with Otsu segmentationand K means clustering, thresholding approach, and many others. These elements generally correspond to something that human beings can without difficulty separate and look at as person gadgets. Computers don't have any way of intelligently spotting systems and such a lot of particular strategies were evolved on the way to section the image. The segmentation system depends on outstanding features found within the image which can be colorings statistics, barriers or phase of an image. The primary step regarding within the MATLAB image processing is shooting of digital excessive-resolution images. The image of the wholesome and damaged regions are captured and saved for in extra experiments. For image enhancement, their images are pre-processed and carried out. The segmentation technique is processed by using the usage of capturing the snapshots of Fruits or leaves and segmenting the images through K means clustering forming clusters. For schooling and classifies the features and extracted earlier than applying the segmentation strategies. Lastly the diseases are recognized by way of the system.

Fig.1: Leaf Diseases of a Tomato plants (a) Early Blight; (b) Septoria Leaf Spot; (c) BacterialSpot (d) Iron Chlirosis.

Basically, the tomato plant disease detection plays a major role since it is a major crop in India. By using K means with convolutional neural network and SVM classifier algorithms the disease is identified and can be displayed. The main drawback of the existing methods is misclassification, accuracy is low, affected area is also not identified accurately. In some algorithms if all the above are estimated correctly but the pesticides used are not perfectly estimated.

Hence in this method, four diseases of the tomato plant are detected and the pesticides are estimated for each disease using k-means clustering, CNN and SVM classifier.

2. IMPLEMENTATION OF PROJECT

Image processing is one of upbringing technology which is helping to resolve such issues with various algorithms and techniques. Most of the diseases of tomato plant detected at initial stages as they affects leaves first. By detecting the diseases at initial stage on leaves will surely avoid impending loss. Agriculture is the major sector in India. Out of which tomato is one of the common food crops in India. Due to which detection of disease on tomato plant becomes important because less susceptibility. The plants productivity gets affected if proper care is not taken.

Digital camera or mobiles with better resolution are used to take images of leaves of different diseases, these images are used in identifying the affected area in leafs. Otsu segmentation techniques are applied on them, to process raw images, to get useful image for further processing and analysis.

In the proposed system four key diseases are identified using image segmentation and Multi-class SVM algorithm [13]. For parting of damaged area on leaves image segmentation is used and for classification of accurate disease Multi-class SVM algorithm is used. In last stage symptoms and treatment to detected diseases recommended user.

This project presents Tomato Plant Leaf Disease Detection using K means, CNN and SVM classifiers along with the use of devices like Raspberry Pi with image processing. Python programming language and MATLAB is used for automation purpose. This project contributes an efficient and fairly cheap automation irrigation system. System once installed has less maintenance cost and is easy to use.

This project focuses on Plant grown and agriculture field with the parameters like soil, temperature, humidity and UV rays. The proposed approach usesK-Means clustering Convolutional Neural Network and SVM classifiers, as it provides high accuracy when compared tomulti-layer perceptrons (MLP). Constant monitoring can help growers make decisions and help manage the causes of problems as opposed to treating symptoms.

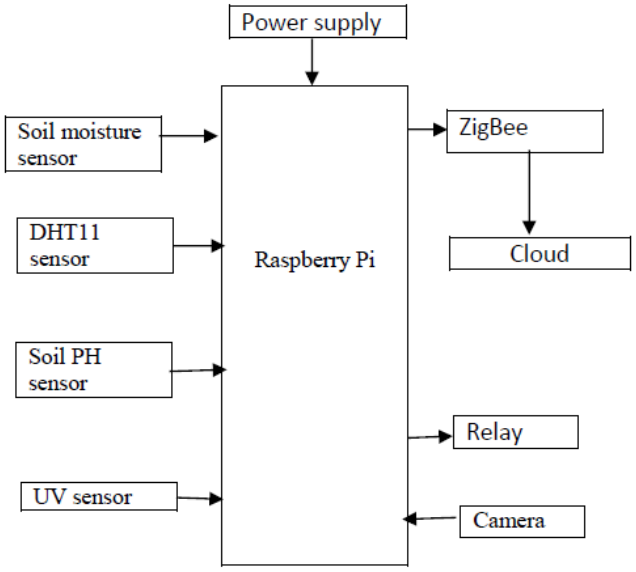


Fig 2: Block Diagram of IOT Based Smart Farming Receiver

In the above Block diagram, we used four sensors, with respective raspberry pi interconnected with Camera and cloud is shown [Fig. 2].The sensors should be connected to some points in the Raspberry Pi. Raspberry Pi consists of 40 pins, in that some are GPIO pins, some are GND, some are IDEEPROM pins and some are few voltage pins. Input and Output devices can be connected to the General Purpose Input. In the above Block diagram, we are interconnected MATLAB with PC and Cloud is shown [Fig. 3].

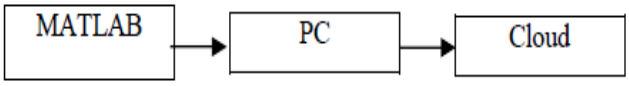


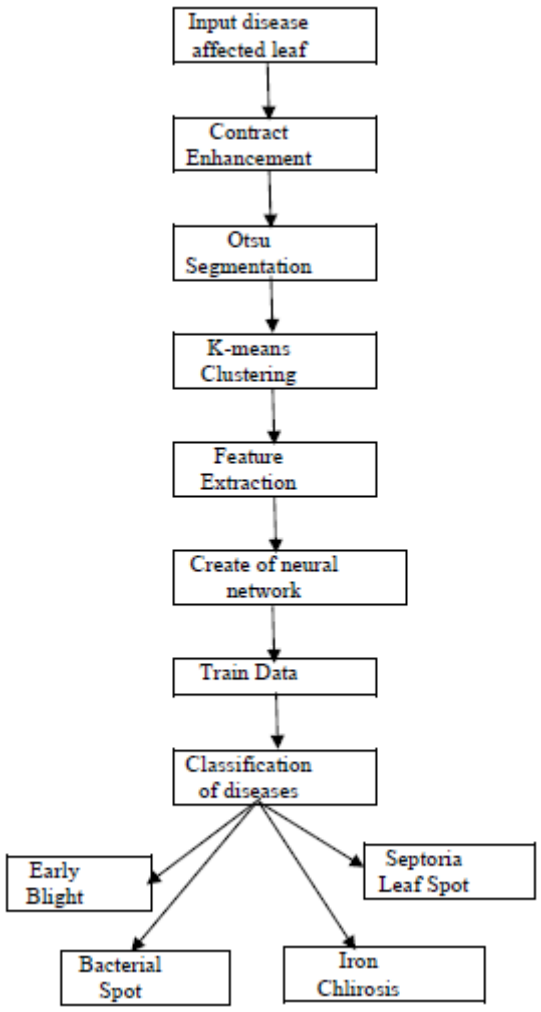
Fig 3: Block Diagram of IOT Based Smart Farming Transmitter

1. Algorithm:

Basic steps describing the proposed algorithm.

1. RGB image acquisition
2. Enhancing the contrast of an image
3. Apply K-means clustering method and select the region of interest (ROI).
4. Features are extracted by using Gray level co-occurrence matrix (GLCM) Texture Statistics Computation
5. Configuring SVM Classifier for classification.
6. Accuracy and percentage of affected portion is calculated.

The proposed technology of a Block diagram for plant disease detection is shown in below Figure-4.



Working of the project:

The working of the project is simple. In this project we detect the plant leaf disease and monitoring and controlling the parameters. We detect leaf disease using digital image processing. Here we are monitoring the environmental physical parameters using sensors like DHT11 sensor, soil moisture sensor, PH sensor. These sensors collect the data and send this data to a raspberry PI. It will process the operation and upload it to the server. The pumping motor will depend upon the soil condition if the soil is wet motor will automatically turn off otherwise it will on.

2. Methodology

A. Image Acquisition:

The images of the plant leaf may be obtained the usage of methods. The first manner is to capture the image the use of the outside digital camera, here I introduced a new digital camera and the second way is to get the photo from the email and many others. The enter photograph is converted to color region

B. Image Pre-Processing:

To eliminate the noise within the photograph, precise pre-processing techniques are considered which incorporates picture clipping for obtaining the concerned location through cropping; image smoothing is achieved to lessen inside the acquired image thru using the smoothing clean out. Image enhancement is executed to grow the evaluation. Contrast is created by means of the distinction in luminance meditated from adjacent surfaces. In different phrases, contrast is the difference in visible properties that

makes an item distinguishable from different objects and the background. In visual perception, evaluation is determined by means of the distinction inside the color and brightness of the item with other items. Our visual device is more sensitive to assessment than absolute luminance; consequently, I will understand the sector in addition no matter the enormous adjustments in illumination situations. Many algorithms for carrying out evaluation enhancement have been developed and implemented to issues in photo processing.

C. Image Segmentation:

Segmentation manner partitioning of a picture into numerous part of the equal feature or having a few similarity. The segmentation may be executed using Otsu's technique, K approach clustering, changing RGB to HSI model and so on. The K approach clustering is used for category of the object based on a fixed of the capabilities into K no. of training. The category of the object is done via minimizing the sum of the square of the space between the item and the corresponding cluster.

D. Feature Extraction:

Feature extraction performs a crucial role in the identity of an object. In many utility of photograph processing, characteristic extraction is used. The features which may be used in plant ailment detection. In this project considers shade, texture and Morphology as a function for disorder detection. They have determined that morphological result gives gray scale higher end result than the opposite functions. Texture means how the shade is sent in the picture, the roughness, hardness of the image. It can also be used for the detection of inflamed plant areas. Color, texture, morphology, and many others. Are the features which can be utilized in plant disease detection. In my assignment for function extraction, I even have converted the photo to grey scale. The photograph that's inside the shade space is transformed into gray image the usage of

$$F(x) = 0.2989*R+0.5876*G+0.114.*B$$

Mobile phones or digital cameras are used to take images of infected to of various plant lives. Image processing techniques have applied those images to get beneficial features for studying. The numerous steps involved are proven in Figure 2. By using the capture photograph to identifies which styles of disease affected by the leafs the system is done to enhance the image because of image is not clear or it is low light condition after the to do the segmentation to divides the different groups for finding the disease and the finally to applies the neural network to find the accuracy of the image.

E. SVM, CNN AND K-MEANS CLUSTERING

"Support Vector Machine" (SVM) is a supervised machine learning algorithm which can be used for both classification and regression challenges. However, it is mostly used in classification problems. In this algorithm, I plot each data item as a point in n-dimensional space (where n is number of features you have) with the value of each feature being the value of a particular coordinate. Then, I perform classification by finding the hyper-plane that differentiate the two classes very well (look at the below snapshot)

Support Vectors are simply the co-ordinates of individual observation. Support Vector Machine is a frontier which best segregates the two classes (hyper-plane/ line).
Convolutional neural networks (CNN) can be used for the creation of a computational 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 learn the required features for classification purposes. They require less pre-processing in comparison to traditional approaches and perform automatic feature extraction which gives better performance.

3. Hard ware requirements

A. Raspberry Pi3:

The raspberry Pi3 is a fundamental model of third era Raspberry Pi. It is supplanted byRaspberry Pi model2 in Feb 2016.

Figure 5: Raspberry Pi board

B. DHT11 Sensor:

DHT11 sensor is used to measure the environmental humidity and temperature. It have resistive elements and NTC temperature measuring devices.DHT11 sensor is high reliability and long term stability.

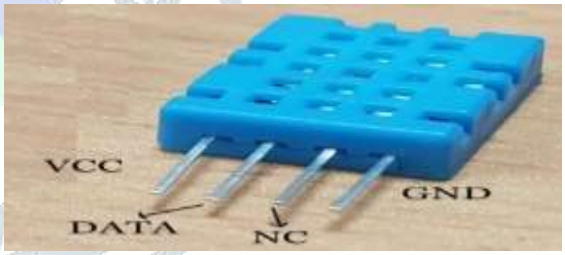


Figure7:*DHT11 sensor*

C. Soil Moisture sensor:

The soil moisture sensor is used to test the moisture level in the soil. if the soil has water shortage it gives output high otherwise low. By using this sensor one can automatically water the flowering plant, or any other plants requiring automatic watering technique.

Figure 8: soil moisture sensor UV sensor:

The UV sensor is used to sense the 240-370nm range of light. It used to detect the intensity of the incident ultraviolet (UV) radiation like sunlight. This form of electromagnetic radiation has shorter wavelengths than visible radiation. The module outputs calibrate analog output voltage which varies with the UV intensity.

Figure 9: UV sensor

D. LCD:

LCD (Liquid Crystal Display) is an electronic display. This is used to display the data on the screen. it is 16X2 LCD is AN electronic show. This is often accustomed to show the values on the screen. It's a 16x2 LCD. This display operates in 8-bit and 4-bit mode.

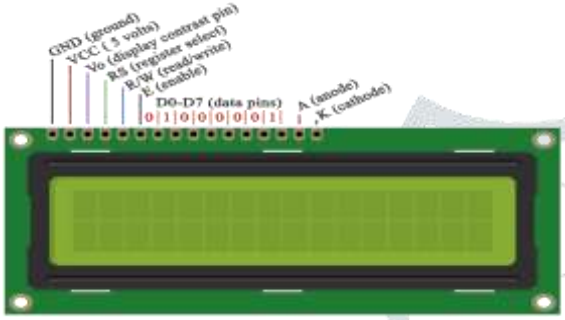


Figure 10: LCD Display

F. ZigBee:

Zigbee is a specification for high-level communication protocols using small, low-power digital radios based on an IEEE 802.15.4-2003 standard for personal area networks. Zigbee is designed for devices that require simple wireless networking and don't need a high data transfer rate.

G. Soil PH sensor:

Soil PH sensor is used in laboratories and Fields to test the PH value of soil and water. This sensor measure the more accurately. The pH of the topsoil measured directly or slurry can be prepared. Soil can be acid, neutral or alkaline, according to its pH value. Most plants prefer a pH range from 5.5 to 7.5, but some species prefer more acid or alkaline soils.

Figure 11: PH sensor

H. Relay:

To conquer this issue Relay is utilized. Here motor is supplied with a separate power supply to the common pin of the relay. And it can be turned ON and OFF by using NC and NO pins of Relay.

Figure 12: Relay

I. Motor:

DC motor which convert electrical energy into mechanical energy. These DC motors are using in robotic applications. This motor drive by using L293D motor driver.

Figure 13: DC motor

J. Web Cam:

A Web cam is virtual camera that is associated with a PC. It can send live pix from wherever it's sited to some other region through the coordinated. Numerous work area workstation screens and PCs accompany an advanced camera and amplifier, yet in the event that yours doesn't, you could include a different webcam whenever.

Fig.14: WEB Camera

4. Software requirements:

- MATLAB
- PYTHON

3. OUTPUT AND RESULTS

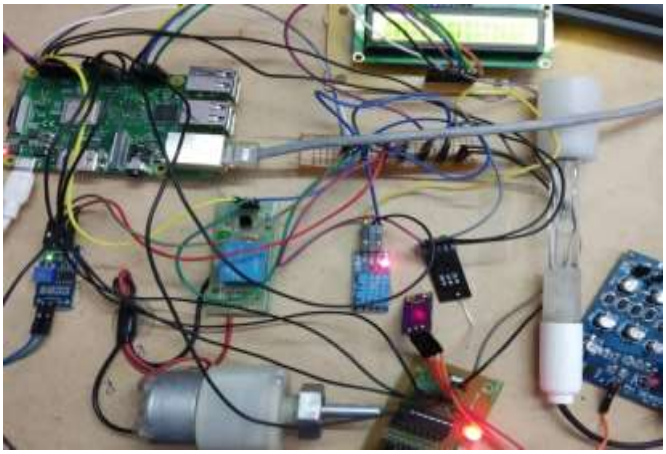


Fig15: Hard ware arrangement of the project

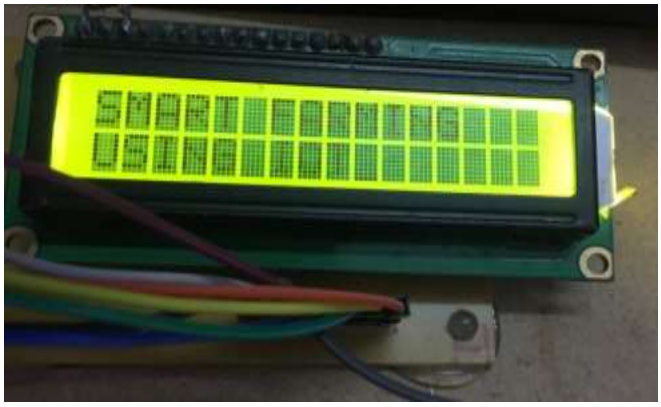


Fig16: Title name display on LCD

Fig17:Moisture and Uv values in LCD

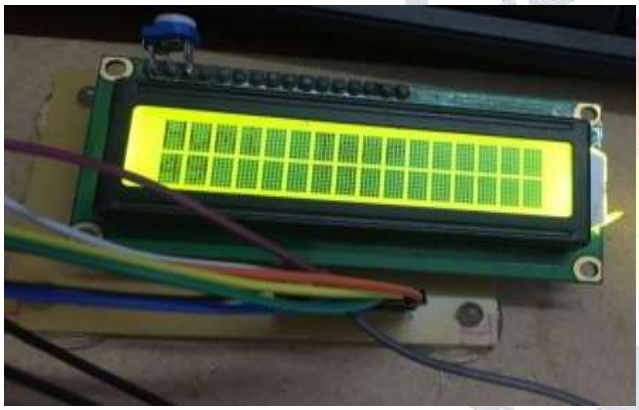


Fig18:Humidity and Temperature values in LCD

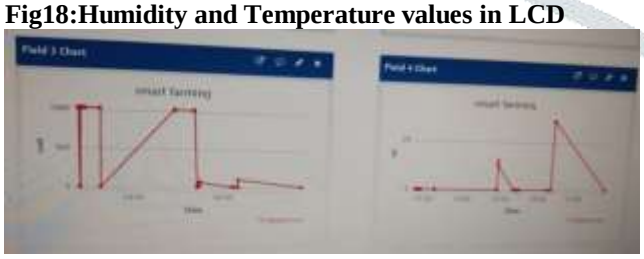


Fig19: Moisture and Uv values in Uploded in server.

Fig20:Humidity and Temperature values in Uploded in server.

Fig 21: Contrast enhanced input image .

Fig 22:K-means clustering of input image clustert 1 is is medium and cluster 2 is low and cluster 3 is high segmented images.

Fig 23: Early blight disease is detected in the above image.

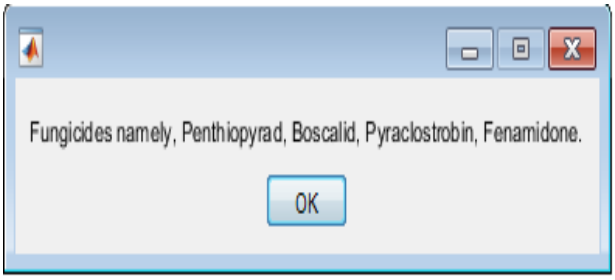
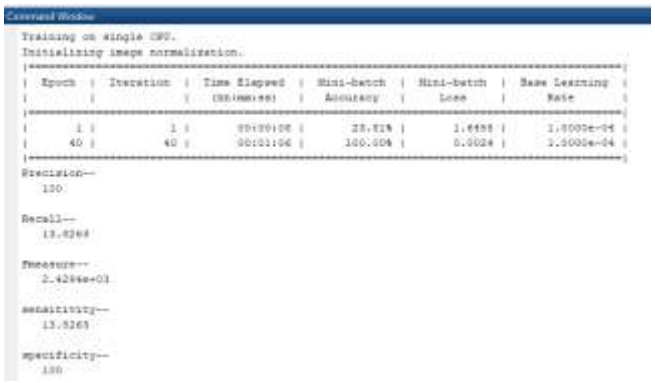


Fig 24:Remide for protecting the leaves from the disease.

Table 1: performance metrics of proposed system



4. CONCLUSION

By the comparing to the existing method with the proposed method it gives the better accuracy results for the identification. Sensors play a major role in plant growth. Each variation in the plant can be detected and updated in to Microcontroller for monitoring and controlling of plant growth based on DHT11 Sensor, Soil PH Sensor, Soil Moisture Sensor, UV Sensor are used. Plant Leaf disease detection help farmers to identify the disease affected area and the type of disease that is affected. Hence, by using K means, CNN and SVM classifier algorithms along with Otsu segmentation technique. I can acquire results with high accuracy. This method provides valid results when compared to the MLP (Multilayer Perceptron) technique. The Proposed system accuracy is increasing 11.0165% compare with existing system accuracy.

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