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Automatic Plant Health Monitoring System in Green House

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Abstract: ***The automatic plant monitoring system has recently attracted tremendous interest due to the potential application in emerging technology. More importantly, this technique is used to enhance the performance of existing techniques or to develop and design new techniques for the growth of plants. The plant monitoring system is helpful for watering the plants and to monitor few parameters like temperature, humidity, and light intensity of the plants. This system is very much useful for the indoor plant cultivation. Another important parameter is by capturing the images of the plant by using IP web camera, and processing the image by using image processing techniques. Image processing is used for the detection of plant diseases. Disease detection involves the steps like image acquisition, image pre-processing, image segmentation, feature extraction and classification***

1. Introduction

Automatic starters are used in most of the agricultural field the purpose of the starter is to switch the motor to ON condition after the temporary failure of an electrical power supply. BUT the main disadvantage is that it needs the personal involvement of the farmer to switch OFF the motor after a particular time. And also the plants are affected due to the climatic changes particularly during the rainy season as well as during the winter season. So to avoid this we use automatic plant health monitoring system. This system can be implemented successfully using various sensors like soil moisture sensor, temperature and humidity sensor, LDR sensors. Watering the plants during the night time is a difficult task for the farmers and therefore based on the output of the soil moisture content during the night the motor will act automatically. And by doing this there will be a proper utilization of water. This process will enhance the growth of plants. The four modes of operation of this system run effectively.

1) When the moisture content of the soil decreases automatically the water pump gets ON.
2) If the temperature and humidity content fall below the threshold value then the Fan and Sprayer will get ON.
3) If the light intensity inside the greenhouse gets affected then the DC Light gets on.[1]

In this we also take the image of the plants leaf and then analyse the image using the image processing. This process is carried out using K mean Clustering Algorithm.[2]

Plant Health Monitoring System

Arrange the field in two different manner in that one operates automatically and the other operates manually. The first sector is provided with soil moisture sensor, temperature and humidity sensor, and the LDR sensor. All these sensors must be inserted properly because their operation plays a major role in the growth of the plants. Next we have to arrange the relay, water pump motor fan, sprayers and the DC light for the entire system and ensure that they are operating at the time or not. The workings of those were clearly explained below. All the sensors, relays, motor, fan, sprayer and the LDR light are connected with the ARDUINO. And therefore the results are displayed through LCD display. Hence the new technique of the plant monitoring system would work with high efficiency and high yield with the less involvement of farmers.

2. Proposed Work

Here we have used three different sensors to monitor the plant and therefore initially we have to collect the analogue output value for all the three sensors. And we have to fix the threshold value for each sensors. If the output analogue value is lesser than the threshold value then it indicates that the soil is in dry condition. So we have to switch on the water motor. The water motor is used to pump the water in to the dry sector to make them wet by using the relay, which will be acting as the switch. If the output of the soil moisture sensor value is greater than the threshold value then it indicates the soil is in wet condition. So that the water motor will automatically OFF, this could be controlled by the relay. We also use DHT11 sensor which measure both the temperature and humidity values in the surrounding environment and based upon that the threshold value is fixed and based on that relay work automatically, similar to this in order to maintain the light intensity inside the greenhouse LDR sensor is used and therefore if the plant is in need of light to all the above we need to monitor the health condition of the plants and therefore the K Means Clustering Algorithm is used and the disease are detected clearly.[6]

Here the leaf is first enchaned then it is segmented into three clusters .Among the three clusters the diseased part is selected and the image is classified to find whether the plant is in healthy condition or not. The features of the plant is also extracted clearly by this algorithm.

Figure 1: Problem faced in outdoor cultivation

3. Basic Sensors

a) Soil Moisture Sensor

Soil moisture is nothing but the presence of water content in the soil. In order to measure the moisture content of the soil we use soil moisture sensor FC-28. It has two conducting probes that act as probe. This can measure the moisture content in the soil based on the change in resistance between the two conducting plate. The resistance between the two conducting plate varies in inverse manner based on the moisture content of the soil. This sensor is equipped with both analog and digital output so that it can be used both in analog and digital mode.

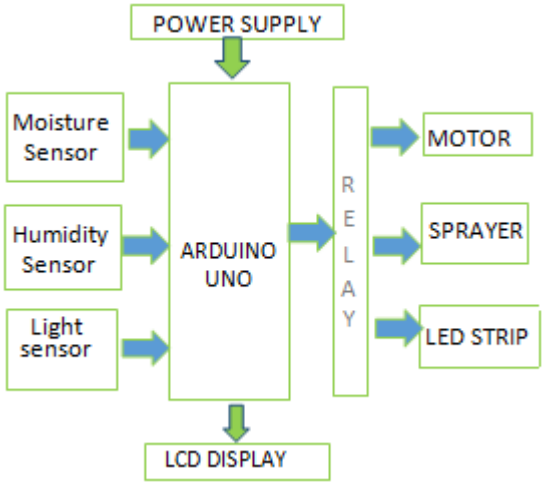
b) DHT11 Sensor

These sensors are very popular for electronics and they are very cheap but still providing great performance. The DHT11 measure the relative humidity and the temperature around the Green House the relative humidity is the amount of water vapour in air vs the saturation point of water vapour in air. At the saturation point the water vapour starts to condense and accumulate on surfaces forming dew. [7]

c) LDR Sensor

An LDR sensor is also called as the photo resistor. It is basically a photocell that works on the principle of photoconductivity. The passive components is basically a **resistor** whose resistance value decreases when the light intensity decreases.

4. Block Diagram



5. Experimental Results

Here we have considered two scenario in demonstrating our project. In this the fig 1.1 show the automatic growth of the plants using various sensors and they are maintained clearly in a greenhouse step up. On the other hand the fig1.2 gives the normal manual method of the growth of the plant. This has been shown to compare the difference between the indoor and outdoor cultivation.[5]

Figure 1.1: Automatic growth of the Plants

Figure 1.2: Manual Growth of the Plants

Plant Disease Detection

The system design mainly consists of
1) Dataset collection
2) Image pre-processing
3) Image Segmentation
4) Feature Extraction
5) Classification using Multiclass SVM

Dataset Collection

In our Project, disease identification is based on Tomato plants. Through **IP WEBCAM** software, images are captured through Mobile Phone. Those images will be stored in the some standard format like **JPEG.** Based on IP Address of the mobile, the image is viewed in Mat lab software. To train and test the system, some of diseased leaves and healthy leaves are taken. The data set collection contain various disease like, bacterial spot, Septorial leaf spot, Tomato mosaic, yellow curved.

Load Image:

Image Pre-processing

Noise gets added during acquisition of leaf image. To remove the noise in the image, pre-processing is considered. This transformation is used to improve the quality of image that better suits for analysing .Pre-processing like Resizing, Enhance contrast and image conversion.

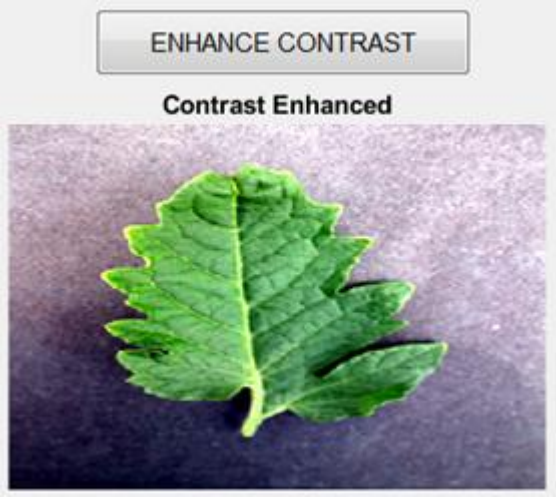


Image Segmentation

During the image segmentation, the given image is separated into a homogenous region based on certain features in this proposed work k mean clustering algorithm is used to segment the given image into three different clusters that contain diseased part of the leaf.

K -mean clustering algorithm

This algorithm is used to categorize those items based on K groups of similarity. Similarities between those items are found through Euclidian Algorithm. K mean clustering algorithm is also called as "Unsupervised Learning" algorithm. [2]

Steps in K Mean Clustering Algorithm

Following are the steps in k-means clustering

1) Read input image of leaf.
2) Convert RGB color space to L*a*b*color space.
3) Classify the colors in a* b* space using k-means clustering.
4) Label every pixel in the image using the results from k-means Create image that segment the original image by color.
5) When segmentation is completed clusters affected is extracted. [4]

Feature Extraction

From the input images the features are extracted. The segmented image is selected by manual interference. Extraction of features of an image is a property in image processing where the major attributes which have to be analyzed are extracted. The **features are mean, standard deviation, entropy, RMS, variance, smoothness, contrast, energy.**

$$Mean = \frac{1}{mn}\sum_{\substack{1\le i\le m\\ 1\le j\le n}} P(i,j)$$

$$Variance(\sigma^2) = \sum_{i=1}^{n} p_i\,(x_i-\mu)^2$$

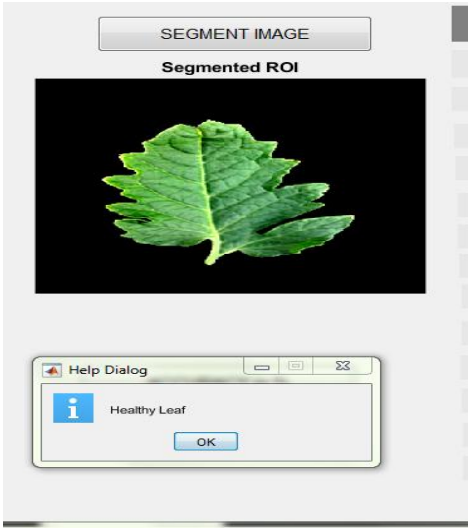
$$Std.\,Deviation = \sqrt{\frac{1}{mn}\sum_{\substack{1\le i\le m\\ 1\le j\le n}} (P(i,j)-\mu))^2}$$

$$Skewness = \frac{1}{mn}\sum_{\substack{0\le i\le m\\ 0\le j\le n}} \left(\frac{P(i,j)-\mu}{\sigma}\right)^3$$

$$Kurtosis = \left[\frac{1}{mn}\sum_{\substack{1\le i\le m\\ 1\le j\le n}} \left(\frac{P(i,j)-\mu}{\sigma}\right)^4\right]$$

SVM Classification

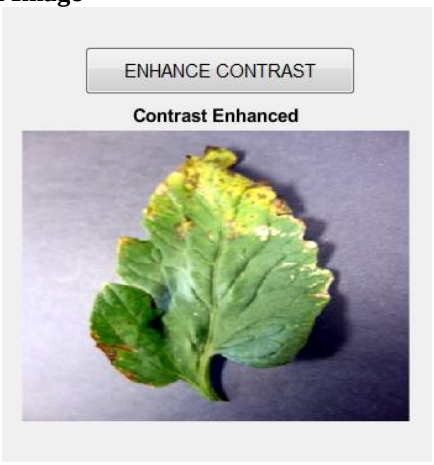
The extracted features are used for classification of the disease. For classification purpose support vector machine algorithm is used. Accuracy percentage of this project is 90.08%.



Results of Diseased Leaf

Load Image

Enhanced Image



Segmented Image

Classification Image:

6. Results and Conclusion

In this system the automatic growth of the plant is maintained effectively with the help of various sensors. And at the same time detection of disease in the plant is also analyzed successfully using the SVM classification. This paper discussed various techniques to segment the disease part of the leaf. From these methods, we can accurately identify and classify various plant diseases using image processing techniques. Thus this model play a major role in monitoring the plant health monitoring system.

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