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Plant Disease Identification and Prevention Using Image Processing and Internet of Things

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Abstract

For over a decade now, agriculture has been the key source of income in India. In a country like India, which is developing now, agriculture provides a huge number of employment opportunities. According to a study, a huge population of the country, around 60-70% of the country depends on agriculture. Most of the work related to farming in India is being done manually because most of the farmers lack the technical knowledge required to do it in a modern way. Pesticides are being sprayed presently on the plants by the farmers but it will have bad effects on the people who consume them. Farmers have no proper idea of what type of crop can be grown on the type of soil they are working on. When different types of diseases affect the plants, where the main part of the plant that gets affected is the leaf, they will suffer a huge loss economically. There will also be a significant decrease in the production of the plants. A leaf is one of the most important parts of the plants. The most challenging job for both the farmers and researchers is the identification of the disease that has affected the leaf. For identifying the plant diseases, farmers need to adapt to too many modern techniques. Through this paper, we will overview various plants and their illnesses and the different propelled procedures that can be utilized to identify these diseases.

Keywords: *Agriculture, plants, diseases*

1. Introduction

The present economy of the Indian subcontinent is profoundly subject to farming. 70% of India's rustic family units still rely upon agribusiness where around 82% of the ranchers are little and peripheral. In 2017, complete nourishment grain creation was assessed to be around 275 million tones. This makes the detection of plant diseases a very important thing. Indian agriculture is composed of many crops like rice, millets, wheat and other commercial crops like jute, opium, rubber. The main source of strength for all these crops is leaves and roots. Many different factors affect the leaves of the plants which result in the exposure of the plant to disease and when the same process is observed throughout the nation, it leads to a decrease in crop production. All this can be avoided by detecting the diseases in plants as early as possible. To properly avoid this situation we need to detect the disease as accurately as possible. While the number of diseases that affect the crop is very high, farmers very often fail to identify them in time and also fail to take the precautions required properly. One way to resolve this issue is by using the image processing techniques which are known for their efficiency and one can rely on them as they have always proved to be useful. These methods might prove to be helpful for the farmers to decrease their effort in treating the plants. A large number of ideas have been proposed by scientists for detecting diseases. In this paper, we will be surveying various diseases that affect the plant and the methods and techniques proposed by various researchers to detect them.

Many types of measures have been taken by the agriculture department for treating and avoiding the plants

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from being affected by various diseases depending on the season. One way through which we can help this situation where farmers have to manually observe the plants is, with the help of automation, where we can use the image processing techniques. Throughout a huge number of years, lots of researchers have conducted many experiments on the leaves of plants to identify a type of disease. Through the automation that we mentioned earlier, we can identify a type of disease as early as possible and by doing so, we can avoid the damage to the plants as much as possible in its early stages itself. We have already mentioned various types of diseases that can be observed in various plants and through observation; we understand that there is a need for continuation of the research to achieve the required levels of results. The task of identifying the diseases is becoming difficult as the time moves on, because finding pathologists is becoming a tough job nowadays. This automation helps us to prevent huge amounts of effort put by the farmers to identify a disease. Moreover, this also helps us to reduce the number of pesticides used for plants and thus helps in reducing its bad effects on the people and animals who consume them.

2. Proposed System

In this proposed model, the Median filter approach is being used to diagnose and eliminate noise in each pixel, allowing the filtration process accurate, and then the HAAR wavelet transformation is used for feature extraction function.

- **Advantages**

1. Improved Pest Control
2. Reduced Environmental risk
3. Better Quality Crop
4. Can help farmers to save Money

- **Applications**

1. Automatic detection of pest and extraction system
2. Smart Irrigation
3. Farm Revolution

1) Different Diseases In Plant

A) Alternaria leaf blight:

Alternaria solani is a fungal pathogen that causes disease named as *EARLY BLIGHT* in plants like potato and tomato. This pathogen produces a "bullseye" patterned leaf spots and can also affect the stem of the plant.

Figure 1: Shows an affected plant leaf by Alternaria solani.

B) *Rice Blast*: This is caused by the fungus *MAGNAPORTHE grisea*. This disease is mainly destructive to upland rice crops.

Figure 2: Shows an affected plant leaf by Rice Blast

C) Leaf Curl

Leaf curl is a disease caused by the TAPHRINA DEFORMANS. This fungus mainly affects leaves, Fruits, and Flowers. When a plant is affected by this disease the leaves get thicken and curl up, then turn gray and yellow.

Figure 3: Shows an affected plant leaf by leaf curl

D) Anthracnose: This is caused by Colletotrichum. The plants which are affected dark, water-soaked lesions on stems, leaves or fruit.

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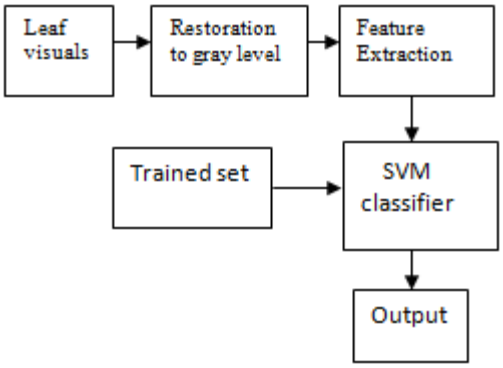
Figure 4: Shows an affected plant leaf by leaf Anthracnose.

2) Methodology



The above square graph clarifies the Step-by-Step process utilized in plant infection recognition. At the point when an ailment influenced plant, leaf picture is given as info the picture experiences following procedures.

A) IMAGE PROCESSING
B) IMAGE SEGMENTATION
C) IMAGE CLASSIFICATION
D) USAGE OF IOT

A) Image Processing

Picture handling change of RGB to Grayscale happens and clamors are evacuated by utilizing a Median filter. The Grayscale picture comprises of monochromatic shades of dark to white. Many pictures alters programs enable you to change over a shading picture too highly contrasting or grayscale. By changing over the Original picture into Grayscale picture all shading data is evacuated by leaving just the luminaries of every pixel. Median Filtering is a technique used to expel clamors in the pictures especially "salt and pepper" type commotion. The Median filtering works by supplanting each an incentive by the middle benefit of neighboring qualities.

Figure 5: Represents the conversion of RGB to Grayscale image.

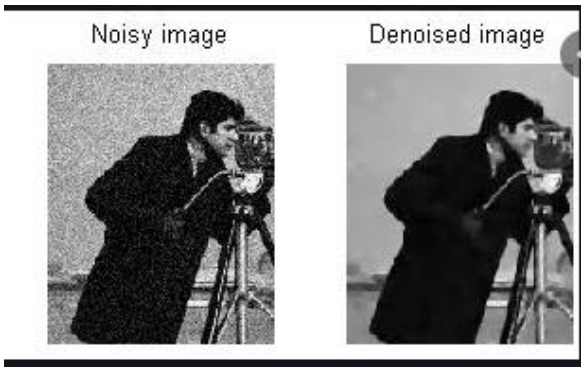


Figure 6: Represents the removal of noise using the median filter.

B) Image Segmentation

In this method, feature extraction is done by using a Haar wavelet transformation method and k-means clustering.

Haar Wavelet approach is utilized to perform both lossless and lossy picture pressure. Haar wavelet is a productive method for image compression. This approach relies upon averaging and differencing values and makes a meager lattice (Sparse matrix). This strategy is utilized in feature extraction.

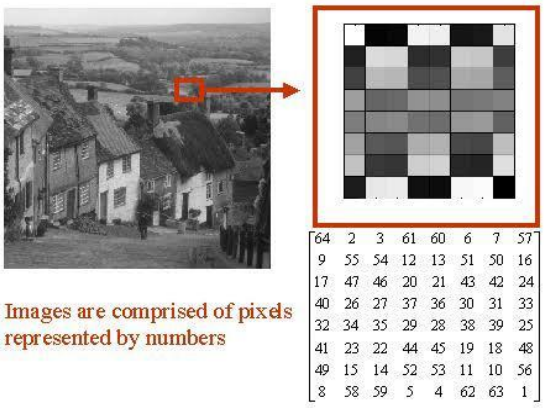


Figure 7: Shows the pixel values of an image in a sparse matrix form.

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Feature Extraction is used in representing the parts of the image. This method is mainly used when the images sizes are large and also used in feature representation of images which helps to complete the tasks faster. Different statistical features are found namely skewness, variance, kurtosis, Rms, entropy, standard deviation, mean, Energy, Correlation contract.

- **Skewness**: Measures how unsymmetrical the appropriation of pixel esteems is.
- **Variance:** Measures how every pixel fluctuates from nearby pixels (or) center pixels and utilized in the grouping of various locales.
- **Kurtosis:** kurtosis values are found in blend with noise and resolution. High kurtosis values should go inseparably with low noise and low resolution.
- **RMS:** RMS means Root mean square used to find image contrast
- **Entropy:** Used in Quantitative Analysis and also used in better comparison of image details.
- **Energy:** Used to calculate the information while performing the Operations on probability bases.
- **Correlation:** Used to extract information from the image.
- **Contrast:** used to find the difference between the highest and lowest values of the adjacent set of pixels.

K-means clustering algorithm is an unsupervised algorithm and it is utilized to segment the particular part from the background. A specific group is being used to generate the first centers and this region unit for the optimization of the picture which is used in the k-mean law.

C) Image Classification

Image classification is done by using the **support vector machine algorithm**. It comes under the umbrella of the machine learning support vector machine algorithm (SVM). Image processing on the other side focuses primarily on the manipulation of images. For example, image filtering, where a selected image when passed through a median filter to be sharpened. If you want to compare the two, then SVM might be used for the image classification process.

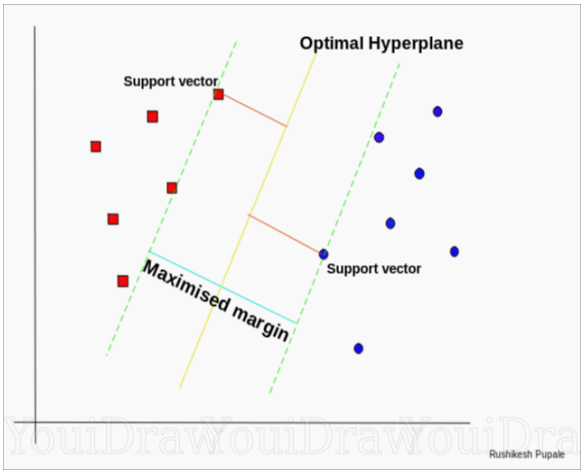

Figure 8: Shows how classification takes place by using hyper plane.

D) Usage Of IoT

After Image Classification, the disease is identified by which the plant is affected. This is given as input to the Arduino so that the respective medicine is given to the plant through water by motors.

A) PIR sensor:

PIR (passive infrared sensor) could be a sensor that measures actinic radiation divergent from the objects .these PIR sensors principally employed in motion detectors.

Figure 9: PIR sensor used as motion detectors.

B) Prevention

As soon as the disease is identified. Disease name acts as an input terminal to Arduino by which Motor operates and supplies medicine to the plant. IC L293D Motor Driver, Arduino and virtual terminal is used for carrying out the prevention process by running motors.

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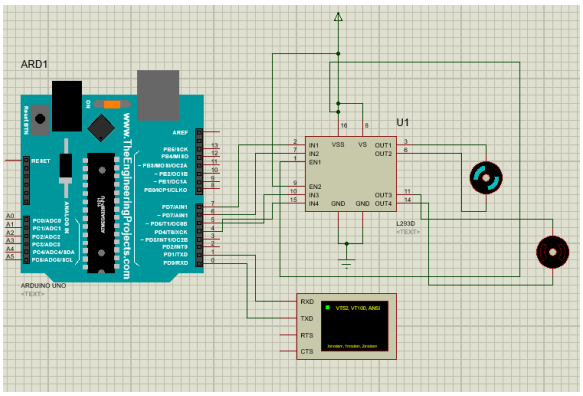

Figure 10: Shows the block diagram and gives the glimpse of prevention part.

3. Literature Survey

[1] In this paper, we will discuss about a process where there are four steps mainly involved in developing the processing scheme, the first one among the steps is, for RBG image which will be given as the input, firstly, a structure of the color transformation is created as, for color descriptor, HSI is used. Also, this RGB is used for the generation of color. In the following step, green pixels are firstly masked and are then removed, with the help of the threshold value. After that, by using the threshold level that is pre-computed, removal of the green pixels followed by their masking is done.

[2] This paper discusses some of the diseases that are observed:

[a]**Bacterial blight**: This is caused mainly by bacteria and is observed in many plants, but the most common plant that gets affected by this disease is the pomegranate. In the fruits which are affected by this disease, we can observe some brownish-black spots, with cracks passing over them.

[b] **Fruit spot:** Here, in this disease, light brownish spots can be observed on the fruit which will then become large and then go on to become the blackish spots on the fruit, this infection might be very dangerous as it might cause death to the plant. The main reason for its cause is the fungus and also, such conditions are favored by rainfall.

[3] This paper tells us about a different approach for the same problem, here we discuss a mobile application which has been developed by adding some simple machine learning. Here firstly, some features are extracted, like the total number of the spots, the area and the level of the grayness. After this in the coming time, we can extract some more complex features like color histograms, also this is capable of ignoring the histograms that are difficult to separate from their background. Based on the "if-else", method, several conclusions can be drawn based on which disease has affected the plant.

[4] This paper shows us the various types of diseases that can be observed on the plant leaves, some of the diseases that we can observe here are,

[a] **Koleroga**: Areca nut is the plant that is most commonly affected by this disease. Fungus phytophthorapalmivora is the main cause of this disease.

[b] **Rust:** This disease is mostly observed on the lower side of the leaf surfaces. During the initial stages, spots are raised, on the leaves. The spots become reddish as time goes on. Leaf postulates then turn into yellowish color and then eventually gets turned into blackish color.

[c] **Leaf curl**: The main symptom that comes with this disease is the curling of the leaf. It can be caused by a type of virus, a genus taphrina, or a fungus.

[5] This paper tells us about deep learning. Deep learning can be stated as a section of the machine learning algorithms that consists of the sequential layers. For each layer, the input is taken from the output of the preceding layer. We can say that the learning process can be unsupervised. The representation algorithms help us in making the optimizations for finding the most convenient way for representing the data. In deep learning, we do not need to perform the feature extraction task and the classification task, as in deep learning the feature extraction is automatically done.

[6] This article explores a structure composed of dual sections, one being the description of the disorder and the characterization of the plant leaf infection. There, the isolation of the leaf was done manually, where all the current system only includes isolation and diagnosis of disease characteristics.

4. Conclusion

Through this paper, we surveyed various diseases that affect the plants used in the agricultural field, the symptoms that are observed in the plants for the respective diseases and the cause for that. Mainly, we conclude by saying that by automating the process by using image processing techniques, we can reduce the efforts, time and money that are spent in curing the disease.

5. Results and discussions

Figure 11: Describes and represents the Grey scale conversion and Noise reduction using median filter as output when leaf image is given as input .

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Figure 12: Indicates the segmented part of the affected area.

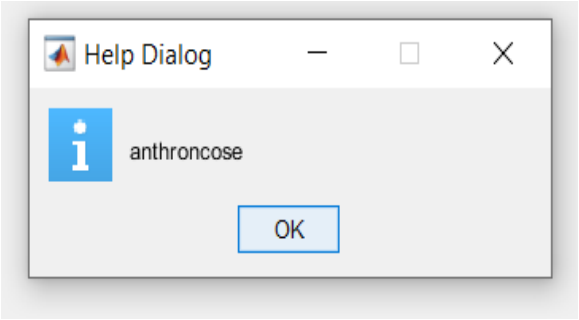

Figure 13: Is the output obtained after classification by using super vector machine (SVM) Algorithm.

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