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Autonomous Farming Robot for Plant Health Indication Using Image Processing

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Abstract: India is an agricultural country and most of the people are farmers. Farmers are cultivating different types of crop. These crops affected by fungi, bacteria, viruses and many more. Identification of disease is very difficult for farmers at its early stage. There are number of diseases found in crop. Farmers cannot be determining accurate percentage of observed disease. Patterns of diseases are so many complexes that finding affected area is difficult. In modern science, taking image of these diseases by using digital camera on robot to collect the data for leaf detection. It is very difficult to monitor the plant diseases manually. It requires tremendous amount of work, expertise in the plant diseases, and also require the excessive processing time. Hence, image processing is used for the detection of plant diseases. Disease detection involves the steps like moving robot mannerly for image acquisition, image pre-processing, image segmentation, feature extraction and classification. In this project we are using computer software which will extract the feature of leaves of plant by using digital camera. The system required the use of vision, with custom algorithms being developed to identify plant growth rates. The entire system will integrated into a fully automated package.

Keywords: Image processing, Plant disease, Plant health.

INTRODUCTION

Agriculture is one of the most important sources for human. It provides food for human and makes financial security and also plays a major vital role in the economy of the country. Disease on plant leads to the significant reduction in both the quality and quantity of agricultural products. The studies of plant disease refer to the studies of visually observable patterns on the plants. Monitoring of health and disease on plant plays an important role in successful cultivation of crops in the farm. In early days, the monitoring and analysis of plant diseases were done manually by the expertise person in that field. This requires tremendous amount of work and also requires excessive processing time. The image processing techniques can be used in the plant disease detection.

In this project, we describe the development of software application that gives users the ability to identify plant leaves disease based on captured images of the plant's leaves taken with digital camera and mobile phone. At the heart of this application is an algorithm that acquires morphological features of the leaves, computers well documented metrics such as the HSV techniques then classifies the diseases based on SVM. The algorithm is first trained against several samples of known leaves diseases and then used to classify unknown query diseases. The algorithm is very successful in properly classifying diseases contained in the training library.

PRESENT SYSTEM

In present system, leaf shape is important to detect the type of disease. For that purpose leaf can be extracted for identification of leaf shape. But there is no such application or program to classify the diseases after capturing its image and distinguishing its attributes yet.

PROPOSED SYSTEM

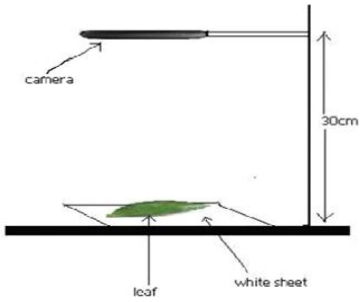
In the proposed system, the application facilitates user to provide the image of the leaf as the input. The system applies algorithm to derive vital parameters related to the properties of the leaf. It then compares these parameters with the ones stored against a leaf entry in the database. On successful match of the parameters, the application displays information related to that particular leaf to the user for his review.

TRAINING

In this module, necessary input is fed by robot to the system in the form of images of the leaf. The system applies necessary steps to extract values for vital parameters from the image. This image along with these parameters with their values and other essential information is stored in the database. These functions are performed by the admin from his login screen.

A] IMAGE ACQUISITION

The images of the plant leaf are captured through the camera. This image is in RGB (Red, Green And Blue) form. Color transformation structure for the RGB leaf image is created, and then, a for the color transformation structure is applied to a device-independent colour space transformation.



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B] IMAGE PRE-PROCESSING

To remove noise in image or other object removal, different pre-processing techniques is considered. Image clipping i.e. cropping of the leaf image to get the interested image region. Image smoothing is done using the smoothing filter. Image enhancement is carried out for increasing the contrast. the RGB images into the grey images using colour conversion using equation (1).

$$f(x)=0.2989*R + 0.5870*G + 0.114.*B - \quad (1)$$

Then the histogram equalization which distributes the intensities of the images is applied on the image to enhance the plant disease images. The cumulative distribution function is used to distribute intensity values.

C] SEGMENTATION

From the given steps, the infected area of the leaf is extracted. The affected region is then segmented into a number of patterns of equal size. The size of the patterns is taken in such a way that the acquired information is not lost. In this way pattern size of 32×32 pixels is taken. The next step is to extract the use required segments. Not all segments contain significant amount of information. So the patterns which contains information almost half of total information are consider for the further analysis.

D] COLOR CO-OCCURRENCE METHOD

Through SGDM the color co-occurrence texture analysis method is developed . To describe shape statistically the gray level co-occurrence methodology is used for statistically sampling the way certain gray levels occur in relation to other gray levels. The probability of pixels is measure by matrices that a pixel at one particular gray level will occur at a distinct distance and orientation from any pixel given that pixel has a second particular gray level. The SGDM's are represented by the function $P(i, j, d, \theta)$ where I represent the gray level of the location (x, y), and j represents the gray level of the pixel at a distance d from location (x, y) at an orientation angle of θ. SGDM's are generated for H image.

E] SVM CLASSIFIER

Support vector machines (SVMs) are a set of related supervised learning methods used for both classification and regression. This type learning involves analyzing a given set of the training set so as to predict the data of unknown future data. Specifically, the goal is to learn some function that describes the relationship between observations and their data. More formally, a support vector machine constructs a hyper plane or set of hyper planes in a high- or infinite-dimensional space, which can be used for classification, regression. a good separation is the hyper plane that has the largest distance to the nearest training data point of any class (so-called functional margin), in general the larger the functional margin the lower the generalization error of the classifier. In the case of support vector machines, a data point is viewed as a p-dimensional vector (a list of p numbers), and we want to know whether we can separate such points with a $(p − 1)$-dimensional hyper plane. This is called a linear classifier.

There are many hyper planes that might classify the data. The best hyper plane is the one that shows the large separation, or margin, between the two classes. So we choose the hyper plane so that the distance from it to the nearest data point on each side is maximized. Multiclass SVM aims to assign data to instances by using support vector machines, where the data are drawn from a finite set of several elements. The best way for doing is to reduce the single multiclass problem into multiple binary classification problems.

ALGORITHM

1. Image Acquisition
a. Image capture from phone
2. Pre-processing
a. Color-grayscale image to binary image
3. Morphological Feature Extraction
a. Centroid-contour Distance Curve
b. Aspect Ratio (AR)
c. Rectangularity (R)
d. Convex Area Ratio (CAR)
e. Convex Perimeter Ratio (CPR)
f. Sphericity (S)
g. Circularity (C)
h. Eccentricity (E)
i. Form Factor (FF)
j. Regional Moments of Inertia (RMI)

ROBOT

Schematic of ROBOT

The components required for ROBOT operation are a camera that would be capture the images of diseases and with the help of AI based embedded algorithm which will pick the regions of affected area and it will perform color transformation to identify the type and growth of disease and it will be connected through wired/Wi-Fi network for expert support from dedicated faculty. In this, the robot is programmed that way that it will take pictures by moving automatically or can be controlled manually on the farmland.

ROBOT Design Considerations

Described robot is designed in such a way that it would have lightweight frame, compact size and sufficient enough to hold all the required components i.e. the main processing kit, camera. Here the portability is also a major concern about robot, so it is designed in such a way that it will do minimum damage to the crops while moving across them. Additional space is left on robot frame so as to convert it into a real time accessing robot by placing TV tuner circuit on it. The algorithms used for detection i.e. image processing is designed to handle the other environmental issues like sunlight or very dim light. The background rejection like the influence of soil in background is addressed in a proper way. The main work of robot i.e. the detection of leaf and its influence in the decision making will be addressed.

CONCLUSION

So due to image processing, leaf detection and classification of disease is successfully implemented and growing of crops easily increases due to this techniques. This paper is discussed about numerous techniques to segment the diseased area of the plant. Feature extraction

and classification methods used for detection of plant disease and health. Mentioned techniques are not too complex and easily used for finding various types of diseases. The use of ANN methods for classification of disease in plants such as back propagation algorithm, SVMs etc. can be efficiently used. From these techniques, we can accurately identify and classify plant diseases using image processing techniques. Our project is going to be useful for farmers for their crops by providing an useful plant leaf identification system and will eventually identify their diseases.

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