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An Approach for Detection of Disease in Carrot using K-Means Clustering

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***Abstract*: Vegetables play a major role in Indian agriculture. Disease detection is the key to prevent the losses in the yield and quantity of agriculture. In India agriculture contributes about 17% of total Indian GDP. Health monitoring on carrot is very critical manually. Images are the important source of data and information in this paper.In the current study, a new segmentation algorithm was developed and texture features for carrot recognition. This paper discusses the method for the detection of diseases using carrot images and the system is proposed to identify and classify the diseases in carrot vegetable using the image processing techniques starting from image acquisition, preprocessing, testing, and training. These retrieved features stored in the database help to categorize the carrot vegetable disease using multiclass SVM.**

***Keywords*: Carrot vegetable disease detection, image processing techniques, K-Means Clustering, Multiclass support vector machine.**

1. Introduction

Identification of vegetable disease is important in agricultural sectors. India is an agricultural country where the chief occupation of the people is agriculture. The yield of the crops is very important to the farmers as it's a source of livelihood to them. Currently the farmers rely on the human disease identification capability for identifying diseases of vegetables which is inaccurate and lacks expertise. Hence a fully automated good identification system is necessary which will identify the diseases of vegetables. Vegetable disease diagnosis is a skill and thus requires expertise. The diagnostic method is essentially visual and requires intuitive judgment and also needs the scientific methods. The photographic image samples disclosing the symptoms and signs of vegetable diseases are very precious in research area, learning process and diagnostic procedure. Early detection of diseases in vegetables is a grand challenge to the agricultural scientists. The pathogens in the diseased vegetables affect the crop yield badly and produce a decline in both the quality and quantity of agriculture produce. The diseases in vegetables have to be controlled in the initial stage of the attack otherwise it will be very cumbersome to control them at a later stage. Due to lack of experience and expertise, farmers are unable to identify the disease in the initial stage. With the fast improvement in the field of computer vision and Image processing technology, it is possible to progress rapidly in identifying the diseases correctly and effectively such as pathogen detection and early warning. One of the hurdles in detecting the diseases is inadequate identification of their occurrence which can be accurately determined by machine vision technology. Vegetables provide important source of nutrients, vitamin, minerals and antioxidants. Eating vegetables provides more health benefits. Peoples can eat more vegetables and fruits as a part of an overall healthy diet likely to have a reduced risk of some chronic diseases. Vegetables are the most important in the agricultural products. Farmers are very concerned about costs involving in Agricultural activities. In the cropping cycle, several diseases and abnormal conditions may affect plants resulting on considerable losses of vegetable production.

Some of the common diseases that affect carrot vegetable are:

- Root nematode
- Sclerotinia Rot
- Black Root Rot
- Cavity Spot

- *Root Nematode:* The most common species which affects the carrot is Meloidogyne javanica. The roots fork and become distorted or suffer from standard taproots, reduced stand, and reduced yield. Numerous knots may be found on the body of the tap root and on the secondary roots. When carrots stay in the soil for lengthy periods in fall and winter, nematodes frequently enter lenticels areas and large galls. Most of the diagnostic symptoms occur beneath the ground and some symptoms can be seen above the ground also.Plants with the disease may show nutrient deficiency symptoms because they have reduced ability to transport nutrients and absorb nutrients from the soil.
- *Sclerotinia Rot:* It is caused by the fungus Sclerotinia sclerotiorum. The symptoms occurring on the carrot are water-soaked, small, soft lesion on the crown part, the roots and white fluffy fungal growth all over the affected tissues.There is a development of soft and decaying tissue. The outer leaves redden and wilt. The disease increases its intensity due to more moisture in the soil and the density of canopy. During the summer

season and with the moist soil the sclerotia germinate and generate apothecia. The apothecia generate microscopic ascospores in millions which get distributed to long distances with the help of wind and rains and even through thunder storms also.

- *Black Rot:* black rot in carrots is caused by fungus Alternaria radicina that can normally be present in the seeds. They have Damping-off of seedlings, blighted foliage, and lower Portions of petioles turn into black and necrotic, there is appearance of black ring in the region around petiole attachment, sunken lesions on taproot. The disease is usually spread through infected seed. The pathogens can exist in the crop debris or in the crop soil for up to many years as spores. The spores may be transferred via wind and water. The diseases during storage may be triggered by high humidity and warm storage temperatures.
- *Cavity Spot:* The cavity spot is generally caused by either Pythium sulcatum or Pythium violae which is the fungus that causes this disease. The root is sunken, elliptical, gray lesions across the root. The outer layer of the root breaks and they develop dark, extended lesions; tiny vertical cracks may be formed on the cavities. Flooded soil also increases the number of cavities formed. Pythium sulcatum infects the carrot and its closely related parts and it can remain alive for minimum two years between carrot crops. Pythium violae has a higher range and can survive for at least five years between the carrot crop.

2. Literature review

In this system is proposed to identify and classify the diseases in carrot using the image processing techniques starting from image acquisition, preprocessing, testing, and training. Segmentation is achieved through Discrete Wavelet Transform (DWT) [1]. Automatic vegetable disease identification can be of great benefit to those users who have little or no information about the crop they are growing. Feature extraction is done by Global Color Histogram (GCH). Such users include farmers, gardeners, home makers who cannot afford the services of an expert agriculture [2]. This paper use textural analysis combined with machine learning techniques to develop measures. Experimental results suggest that Histogram of Oriented Gradients (HOG) features outperform Gray Level Co-occurrence Matrix(GLCM) features for the discrimination of phenological stage [5].

Disease infection to agricultural products like plants, fruits and vegetables, results in degradation of quality and quantity of agriculture products. Popular methods have utilized machine learning, image processing and classification based approaches to identify and detect the diseases on agricultural products [3]. The specimens were collected on the sticky traps that were captured by the 4 wireless cameras installed in the paddy field. These images were used both in the development and system testing. Neural network mechanism will be used to identify and classify the detected pests [4].

3. Proposed system

A. *Image capturing*

This step involves capturing the images of carrot vegetable of good quality and diseased carrot (Root nematode, Sclerotinia Rot, Black Root Rot, Cavity Spot.) with high clarity, i.e. with good brightness and contrast. The first stage starts with talking a collection of carrot images.

B. *Image Preprocessing*

Image preprocessing takes place on the images at the lower level wherever image information consists of distortion and the noise, and enhancement of the image is done for further processing.

C. *Apply K-means clustering*

In segmentation, we used K-means clustering method for partitioning of images into clusters in which at least one part of cluster contain image with major area of diseased part. The k-means clustering algorithm is applied to classify the objects into K number of classes according to set of features. The classification is done by minimizing sum of square of distances between data objects and the corresponding cluster. Image is converted from RGB Color Space to L*a*b* Color Space in which the L*a*b* space consists of a lumino site layer 'L*', chromaticity-layer 'a*' and 'b*'. All of the color information is in the 'a*' and 'b*' layers and colors are classified using K-Means clustering in 'a*b*' space. From the results of K-means, labelling of each pixel in the image is done also segmented images are generated which contain diseases. In this experiment we used segmentation technique so input image is partitioned into three clusters for good segmentation result. The carrot image segmentation with three clusters formed by K-means clustering method.

D. *Gray level co-occurance matrix Features*

Feature extraction is very important and essential step to extract region of interest. In our proposed method the basic features are mean, standard deviation, entropy, IDM, RMS, variance, smoothness, skewness, kurtosis, contrast, correlation, energy and homogeneity are calculated and considered as feature values. Then we have created the feature vector for these values. The segmented method shows different values for images. In feature extraction desired feature vectors such as color, texture, morphology and structure are extracted. Feature extraction is method for involving number of resources required to describe a large set of data accurately. Statistical texture features are obtained by Gray level co-occurrence matrix (GLCM) formula for texture analysis and texture features are calculated from statistical distribution of observed intensity combinations at the specified position relative to others.

Numbers of gray levels are important in GLCM also statistics are categorized into order of first, second & higher for number of intensity points in each combination. Different statistical texture features of GLCM are energy, sum entropy, covariance, information measure of correlation, entropy, contrast and inverse difference and difference entropy.

E. Classification of disease

The binary classifier which makes use of the hyper-plane which is also called as the decision boundary between two of the classes is called as Support Vector machine (SVM). Some of the problems of pattern recognition like texture classification make use of SVM. Mapping of nonlinear input data to the linear data provides good classification in high dimensional space in SVM.

The marginal distance is maximized between different classes by SVM. Different kernels are used to divide the classes. SVM is basically binary classifier which determines the hyper plane in dividing two classes. The boundary is maximized between the hyper plane and the two classes. The samples that are nearest to the margin will be selected in determining the hyper plane are called as support vectors. Multiclass classification is also possible either by using one-to-one or one-to-many. The highest output function will be determined as the winning class. Classification is performed by considering a larger number of support vectors of the training samples. The standard form of SVM was intended for two-class problems. However, in real life situations, it is often necessary to separate more than two classes at the same time. SVM can be extended from binary problems to multi classification problems with k classes where $k > 2$. There are two approaches, namely the one- against-one approach and the one-against-all approach. In fact, multi-class SVM converts the data set to quite a few binary problems. For example, in one-to-one approach binary SVM is trained for every two classes of data to construct a decision function. Hence there are $k\ (k-1)/2$ decision functions for the k-class problem. Suppose $k = 15$, 105 binary classifiers need to be trained. This suggests large training times. In the classification stage, a voting strategy is used where the testing point is designated to be in a class having the maximum number of votes.

- *Training:* To train the features, the binary SVM to multi class SVM procedure is done. Train SVM using kernel function of choice. The output will contain the SVM structure and information of support vectors, bias value etc., and find the class of the input image. Depending on the outcome species, the label to the next image is given. Add the features set to the database.
- *Testing:* In the testing phase for the testing the type of carrot disease the user is supposed to follow the same procedure till feature extraction to extract the features. The system uses an inbuilt function "sim" which compares the extracted features of the carrot images under test conditions to all the carrot images features stored in the database, if the features are matched it displays the appropriate result to the user, else it displays it as "Unknown carrot".

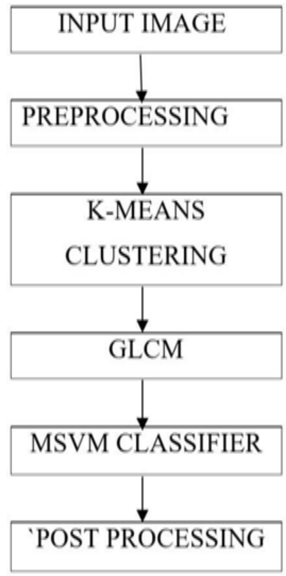

Fig. 1. Algorithm used for Identification and classification of disease in carrot vegetable

4. Result analysis

A. Input image

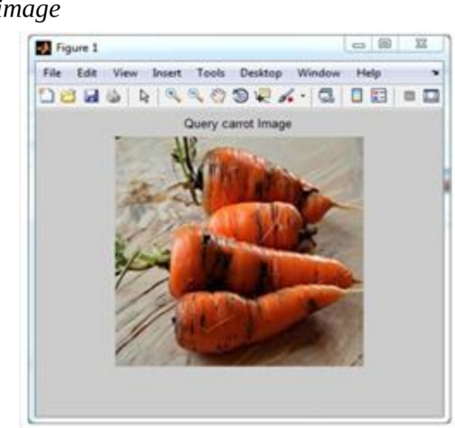

Fig. 2. Shows the input query image

B. Image enhancement

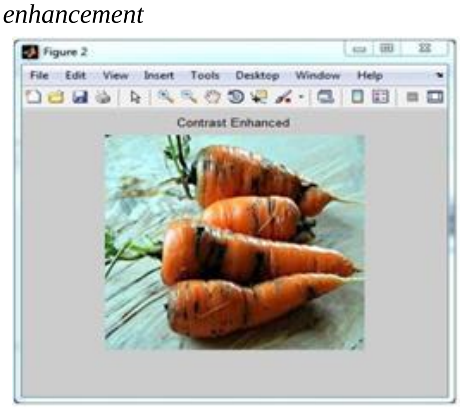

Fig. 3. Shows the result of contrast enhanced

C. *Segmented image*

Fig. 4. Shows the result after applying K-Means clustering

D. *Identification & Classification of carrot*

Fig. 5. Shows the carrot is classified as diseased.

Fig. 6. Shows the carrot is classified as healthy and non-diseased.

5. Conclusion

The goal to identify vegetable diseases was accomplished. The developed system is used for carrot disease identification, there is a need for the development of high-quality classification methods and accurate feature extraction, which is very significant to execute the system in actual operating environment. The accurate detection and classification of the disease in a particular vegetable is very important for the successful cultivation and this can be done using image processing. This paper also discussed some feature extraction using texture and classification techniques to extract the features and can also detect the affected area, perimeter, eccentricity, entropy, etc., K-means clustering algorithm is used for segmentation and classification is done by multiclass support vector machine to identify the condition of the carrot vegetable.

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