Image Processing for Pomegranate Disease Detection: A Survey

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ABSTRACT
In India, agricultural field plays vital role in the development of India. Smart farming is about empowering today's farmers with the decision tools and automation technologies that seamlessly integrate products, knowledge and services for better productivity, quality and profit. Fruit crops are being affected by uneven climatic conditions leading to decreased agricultural yield. This affects global agricultural economy. Moreover, condition becomes even worst when the crops are infected by any disease. Also, increasing population burdens farmers to increase yield. This is where modern agricultural techniques and systems are needed to detect and prevent the crops from being effected by different diseases. This paper is a review of various methods and techniques, which is used to detect the disease of fruit crops and grading. The methods requires input image of a fruit and gives output that fruit is infected or not. Currently there are many different methods available for it. In this paper, different disease detection methods with their prospects are reviewed.

KEYWORDS: bacterial blight, morphology, color, texture, segmentation

INTRODUCTION

India is developing country. During this development contribution of agricultural field is major. Sensible farming is about empowering today's farmers with the choice tools and automation technologies that seamlessly integrate product, data and services for higher productivity, quality and profit.

The classical approach for detection and identification of fruit diseases relies on the eye observation by the specialists. In some developing countries, consulting experts are pricey
and time consuming due to the distant locations of their availability. Automatic detection of fruit diseases is important to automatically detect the symptoms of diseases as early as they seem on the growing fruits.

Some systems have lined apple, mango and grapes etc. There are numerous fruits still remaining that are exported from India and provides a lot of profit to the farmers need to be covered under automatic fruit disease detection system. Pomegranate is the one amongst the fruit that's taken within the low rain space region of the Maharahstra state of India.

The pomegranate (fig.1) is a naturally dense, deciduous, bushy, multi-stemmed shrub that typically grows to heights of 10 to 12 feet and bears highly colored fruit with many juicy seeds inside. The fruits of pomegranate are known to posses pharmaceutical and therapeutic properties. It is a symbol of health, fertility, eternal life and also being valued as medicinal plant. The fruit has a wide consumer preference for its attractive, juicy, sweet, acidic and refreshing arils. There is a growing demand for good quality fruits both for fresh use and processing into juice, syrup and wine. Area under pomegranate is increasing worldwide because of its hardy nature, wider adaptability, and drought tolerance, higher yield levels with excellent keeping quality and remunerative prices in domestic as well as export market.

![Figure-1 Pomegranate Fruit](image)

Now days this fruit is below the attack of one major disease referred to as bacterial blight (Figure-2) due to that farmer’s faces economical loss. This disease is very powerful within the cloudy surroundings and within the rainy season. Symptoms of bacterial blight on young and developing pomegranate fruits are initially, spots are black and round and encircled by bacterial ooze. Under favorable conditions, spots enlarge to become raised, dark brown lesions with indefinite margins that cause the fruit to crack. The disease might cause up to 90% yield reduction.

![Figure-2 Bacterial Blight on Pomegranate Fruit](image)

This disease got to be controlled within the primary stage of the infection otherwise it’ll tough to control it within the final state. Because of the shortage of information farmers aren’t able to identify it exactly at the first stage.
LITERATURE SURVEY

The author Manisha Bhave (2015) provided an approach for fruit disease detection based on image processing. The purpose of research work is to detect disease on fruit. Pomegranate is selected for conducting experiments. Color, morphology and color coherence vector are chosen for feature extraction. Two image databases has taken for detection of fruit disease, one for training purpose and other for testing. In the training phase, firstly input image is acquired then image pre-processing is done for resizing the images. Then feature extraction is carried out. After that, clustering is performed by applying K-means clustering algorithm and then finally classification is performed using SVM. In the testing phase input image acquired from user, then pre-processing, feature extraction is carried out and finally the image will be classified as disease infected or non-infected. They proposed system which provides two methods for the user to check the disease infection for the input pomegranate image as- with intent search and without intent search [1]. The overall system accuracy is measured to be 82%. In future, the system can be improved with the new features incorporated as- training the system to detect diseases accurately, increase dataset size to improve the overall system performance to detect diseases more accurately.

In [2] Monika Jhuria, Ashwini Kumar (2013) suggested an image processing approach for detection of disease and fruit grading. The main goal of research work is to analyze disease on fruit/leaf of fruits and provide alternative solutions. The work has done on fruits specifically Apple and grapes. Image processing techniques are used for fruit disease detection and Color, Texture and morphology features are considered for feature extraction. The fruit grade is decide on the basis of disease spreading and weight of fruit.

Ilaria Pertot (2012) provided multilingual web-based tool for visual plant disease identification. The system has 2 users. User who can use disease identification process for diagnostic and super user who can update system (add/ delete/ modify images, disease). This system is developed for identification various diseases on strawberry. The grower in the field analyzes the symptomic plant and compare symptoms on plant with images provided by web based system. The system responds with identification of most probable disease [3].

Tejal Deshpande (2014) projected an automatic grading of disease on the pomegranate plant leaves. Bacterial blight disease is chosen for the research work. Manual grading is time consuming therefore automatic grading system becomes beneficial. K-means clustering technique is used for conducting image segmentation and disease detection. Total leaf area (At) and total disease area (Ad) is calculated. After calculating at and Ad, disease grading has been done [4]. This system is helpful for plant pathologists and not for the farmers directly.

In [5], Jagdish Pujari (2013) used some applied mathematics methods for detecting fruit fungal disease. The fruits chosen for research work are particularly Pomegranate, mango and grapes. Two phases are used for image preprocessing. In 1st phase, input image is preprocessed for binarization and noise removal. In second phase image is thinned and bounding box is generated. Block wise feature extraction technique is used for feature extraction. During this technique image is split in 5*5 blocks. Textual features are extracted using GLCM (gray level co-occurrence matrix).
The author Shiv Ram Dubey (2012) proposed an image processing approach has been used for fruit disease identification. The research has conducted for apple disease particularly apple scab, apple rot, apple blotch. K-means clustering technique is used for image segmentation. Feature extraction is completed from segmented images. Features considered for feature extraction are color histogram, color coherence vector, local binary patterns and complete local binary patterns \cite{6}. Multiclass support vector machine is used for fruit disease identification.

**METHODS AND TECHNIQUES**

For fruit disease detection, Image preprocessing is required for enhancing images. The next step is image segmentation is required; otherwise the feature of no infected region will dominate over the feature of infected region. After segmentation, feature extraction is done from segmented image and finally the training and classification are performed.

1. **Image Preprocessing**

Image pre-processing involves removing low frequency background noise, normalizing the intensity of individual particles images, removing reflection and masking portion of images \cite{7}. It is the technique for enhancing data images prior to computational processing.

Pre-processing required for shadow removal, image correction. Shadow removal is very important because shadow may disturb segmentation and feature extraction. Initially, captured pictures are resized to a fixed resolution therefore on utilize the storage capacity or to reduce the process burden within the later process. Noise is inevitable throughout image acquisition or transmission. Noise would disturb the segmentation and therefore the feature extraction of disease spots. So that they should be removed or weakened before any further image analysis by applying an appropriate image filtering operation. In \cite{7} authors have considered Gaussian filter to filter out the input pictures.

2. **Feature Extraction**

It is the process of generating the features to be used in selection and classification. Color, Morphology and Texture feature vectors are used for feature extraction.

2.1 **Color:**

A color feature is widely used visual feature. Color image processing is categorized into three principle areas:

- Color transformation
- Spatial processing of individual color planes
- Color vector processing

A color histogram represents the distribution of color in image. Here, color histogram is computed for all images in database and save in database which can be used for comparison of query image with database image \cite{8}.

Algorithm for Image comparison based on Histogram
Input: img1:image1, img2:image2
Output: Image similarity in percentage
1. hist1=compute hist(img1).
2. hist2=compute hist(img2).
3. For each colour code R,G,B follow step 4
4. dist= \( \sqrt{(hist1\text{-color}) - (hist2\text{-color})^2} \)
5. agg_dist=agg_dist+dist.
6. return(agg dist).

2.2 Morphology
Morphology is tool used for extracting image components. These image components are useful in description and representation of region shape such as boundaries. By using morphology, we will extract disease shape vector from healthy fruit and leaf. After applying erosion operation, we get image boundary by subtracting eroded images from original image. By using morphology, we will extract disease shape vector from healthy fruit.

Algorithm for Image Morphology
Input: img:image1
Output: borderedImage:image
1. eroded=erod image(img).
2. borderedImage
3. For each pixel p in img and p2 in eroded perform step 3.
4. bordered image pixel = p1 - p2;
5. return(borderedImage).

2.3 Texture
Texture describe visual patterns, each having properties of homogeneity. Image texture provides information about spatial arrangements of color of an image \(^8\).

2.4 Color Coherence Vector:
It is a histogram-based methodology for comparing images that includes spatial information. In this technique, every pixel in a given color bucket is classified as either coherent pixel or incoherent pixel. Classification of each pixel is based on whether or not it's a part of a large similarly-colored region \(^9\). Coherent pixels are a part of some sizable contiguous region, whereas incoherent pixels aren't belongs to some sizable region.
3. Clustering
Many clustering algorithm is there for image segmentation and classification. K-means algorithm gives better result. When we deal with larger dataset, K-means clustering algorithm gives greater efficiency \[^{[1]}\].

Algorithm for K-means Clustering:
Input: Dataset (Pomegranate fruit image), K number of desired clusters.
Output: K set of clusters.

3.1.1 Initialize the number of cluster $k$, and also pick initial centroid randomly.
3.1.2 The squared Euclidean distance will be calculated from each image to each cluster is computed, and each object is assigned to the closest cluster.
3.1.3 For each cluster, the new centroid is computed and each seed value is now replaced by the respective cluster centroid.
3.1.4 Euclidean distance from an object to each cluster is calculated, and the image is allotted to the cluster with the smallest Euclidean distance.

4. Training and Classification
Support Vector Machine (SVM) algorithm is used for training and classification. Support vector machine find out the linear separating hyper plane that maximize margin and can be used for classification \[^{[1]}\]. SVM uses a nonlinear data into higher dimensions. Dimension boundary separate tuples from one class to another. The training time of Support vector machine is slow however they're highly accurate. After applying SVM, clusters will classify into 2 classes with labels disease infected images and non-infected images. Infected image class consist fruit images affected by bacterial blight and non-infected image class includes healthy fruit images.

METHODOLOGY FRAMEWORK

![Methodology Framework of Disease Detection](image-url)

Figure-3 Methodology Framework of Disease Detection \[^{[8]}\]
The methodology for detect disease in pomegranate is shown in Figure-3 [8]. They have taken two databases, one for training purpose and other for testing.

CONCLUSION
Bacterial blight and other diseases are identified on pomegranate fruit and leaf based on image processing. Once the disease is detected by system, proper treatment can be suggested. The most of systems used pre processing, segmentation, feature extraction, training and classification for detection. But the systems are useful for the plant pathologists, not directly useful for farmers.

REFERENCES