IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, June 2024

Fruit Disease Detection and Classification

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Abstract: *Diseases in fruit cause devastating problem in economic losses and production in agricultural industry worldwide. In this paper, a solution for the detection and classification of fruit diseases is proposed and experimentally validated. The image processing based proposed approach is composed of the following steps; in the first step K-Means clustering technique is used for the image segmentation, in the second step some features are extracted from the segmented image, and finally images are classified into one of the classes by using a Support Vector Machine. Our experimental results express that the proposed solution can significantly support accurate detection and automatic classification of fruit diseases.*

Keywords: K-Means Clustering; Support Vector Machine;Texture Classification

I. INTRODUCTION

The classical approach for detection and identification of fruit diseases is based on the naked eye observation by the experts. In some developing countries, consulting experts areexpensive and time consuming due to the distant locations of their availability. Automatic detection of fruit diseases is essential to automatically detect the symptoms of diseases as early as they appear on the growing fruits. Fruit diseases can cause major losses in yield and quality appeared in harvesting. To know what control factors to take next year toavoid losses, it is crucial to recognize what is being observed. Some disease also infects other areas of the tree causing diseases of twigs, leaves, and branches. For example, some common diseases of apple fruits are apple scab, apple rot, and apple blotch. Apple scabs are gray or brown corky spots. Apple rot infections produce slightly sunken, circular brown or black spots that may be covered by a red halo. Apple blotch is a fungal disease and appears on the surface of the fruit as dark, irregular or lobed edges. Visual inspection of apples is already automated in the industry by machine vision with respect to size and color. However, detection of defects is still problematic due to natural variability of skincolor in different types of fruits, high variance of defect types, and presence of stem/calyx. The studies of fruit can be determined by apparent patterns of specific fruit and it is critical to monitor health and detect disease within a fruit. Through proper management action such as pesticides, fungicides and chemical applications one can promote control of diseases which interns improve quality. There are various approaches available such as spectroscopic and imaging technology, applied to achieve better plant diseasecontrol and management.

The increased in amount of commercialization agricultural farms are always on the look out to reduce man power in whatever way possible without affecting the productivity. A particular aspect to look upon is to use automatic harvesters which would significantly economize the entire process. Fruit detection system has its major application in robotic harvesting q. However the technology can be custom made to be suitable for other applications such as disease detection, maturity detection, tree yield monitoring and other similar operations.

Varieties of fruits are being exported all over the world with the development in cold storage facilities and transportation. It becomes the necessity of maintaining the highest level export quality which is mainly carried out by visual checking by experts. This is expensive and time consuming due to distant location of farms. Precision Agriculture helps the farmers to provide with sufficient and economical information and control technology due to the development and disclosure in various fields. The objectives are agricultural input systemization, profit hike and environmental damage reduction. So, in this work, a solution for the detection and classification of fruit diseases is proposed and experimentally validated. This system takes input as image of fruit and identifies it as infected or non-infected. The technique which helps the farmers to identifydisease properly by using this proposed work.

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II. RELATED WORK

S. B. Ullagaddi, Dr. S.Vishwanadha Raju, "A Review of techniques for Automatic detection and diagnose of mango Pathologies".
Proposed Work:
This paper presents a review on methods that use digital image processing techniques to detect, recognize andclassify plant diseases from digital image and concludes with discussion of more useful problems in the domain and future direction.
Hadha Afrisal, Muhammad Faris, Guntur Utomo P, LafionaGrezelda, Indah Soesanti, Mochammad Andri F, "Portable

Smart Sorting and Grading Machine for Fruits UsingComputer Vision".
Proposed Work:
This paper discusses the development of portable fruit sorting and grading machine based on computer vision for small agro-industries. The mechanical system is designed from low cost material in the form of inclined and segmented plane to substitute the utilization of conveyor belt.

Dah-Jye Lee, James K. Archibald and Guangming Xiong, "Rapid Color Grading for Fruit Quality Evaluation Using Direct Color Mapping**".**
Proposed Work:
In this paper present an effective and user-friendly color mapping concept for automated color grading that is well suited for commercial production. User friendliness is often viewed by the industry as a very important factor to the acceptance and success of automation equipment.

Akira Mizushima, Renfu Lu. "An image segmentation method for apple sorting and grading using support vector machine and Otsu's method".
Proposed Work:
This paper reports on the development of an automatic adjustable algorithm for segmentation of color images, usinglinear support vector machine (SVM) and Otsu's thresholding method, for apple sorting and grading. The method automatically adjusts the classification hyper planecalculated by using linear SVM and requires minimum training and time.

Chandra Sekhar Nandi, Bipan Tudu, Chiranjib Koley. "An Automated Machine Vision Based System for Fruit Sorting and Grading".
Proposed Work:
The paper presents a computer vision based system for automatic grading and sorting of agricultural products like Mango (Mangifera indica L.) based on maturity level. The application of machine vision based system, aimed to replace manual based technique for grading and sorting of fruit.
Manisha Bhangea, H.A.Hingoliwala, "Smart Farming: Pomegranate Disease Detection Using Image Processing".
Proposed Work:
This paper, propose a web based tool that helps farmers for identifying fruit disease by uploading fruit image to the system. The system has an already trained dataset of images for the pomegranate fruit. Input image given by the user undergoes several processing steps to detect the severity ofdisease by comparing with the trained dataset images.

Cihan Akin, Murvet Kirci, Ece Olcay Gunes, Yuksel Cakir "Detection of the Pomegranate Fruits On Tree Using Image Processing".
Proposed Work:
This study a method is proposed for detect pomegranate fruits on the tree and find the number of overall pomegranates using near camera images obtained from thestations established the groves. The pomegranate has significant red color, so a color-based method is applied for to detect the fruits on the tree. Color alone cannot provide a sufficiently robust algorithm for the detection of the pomegranate.

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Mrunmayee Dhakate, Ingole A. B, "Diagnosis of Pomegranate Plant Diseases using Neural Network".

Proposed Work:

The work proposes an image processing and neural network methods to deal with the main issues of phytopathology i.e. disease detection and classification. The Pomegranate fruit as well as the leaves are affected by various diseases caused by fungus, bacteria and the climatic conditions. These diseases are like Bacterial Blight, Fruit Spot, Fruit rot and Leaf spot. The system uses some images for training, some for testing purpose and so on. The color images are pre-processed and undergo k-means clustering segmentation.

III. EXISTING SYSTEM

In existing system, three normal infections of apple fruit are considered i.e. Apple scab, apple rot and apple blotch. The image processing based existing methodology is made out of the accompanying some state of the art color and texture features are extracted from the test image, then color and texture features are fused together and random forest classifier is used for diseases classification

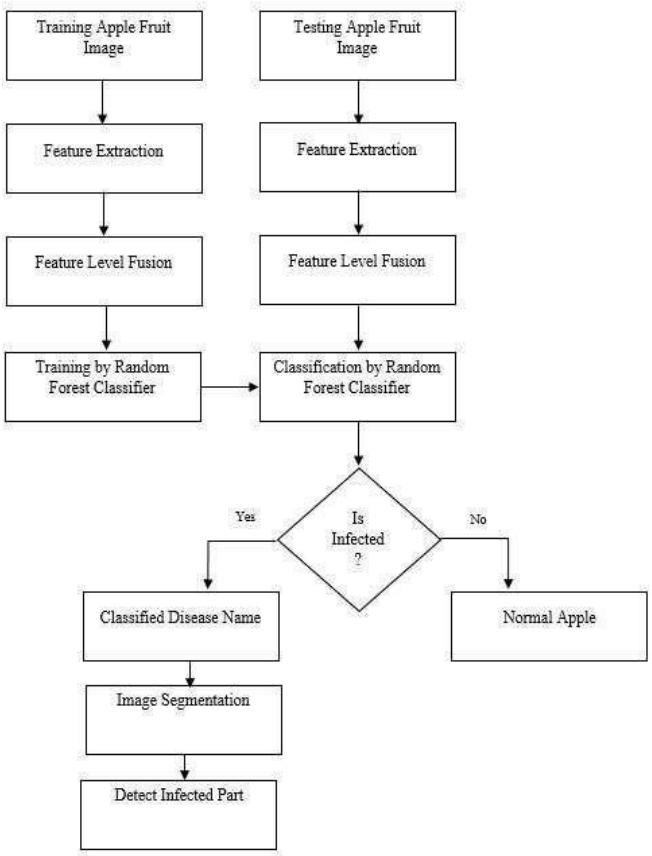

Fig1. Existing System Architecture

IV. PROPOSED SYSTEM

For the fruit disease classification problem, precise image segmentation is required; otherwise the features of the non infected region will dominate over the features of the infected region. In this approach K-Means based image segmentation is preferred to detect the region of interest which is the infected part only. After segmentation, features are extracted from the segmented image of the fruit. Finally, training and classification are performed on a SVM classifier.

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Advantages of Proposed System:

- It would promote Indian Farmers to do smart farming which helps to take time to time decisions which also save time and reduce loss of fruit due todiseases.
- The leading objective of our paper is to enhance thevalue of fruit disease detection.

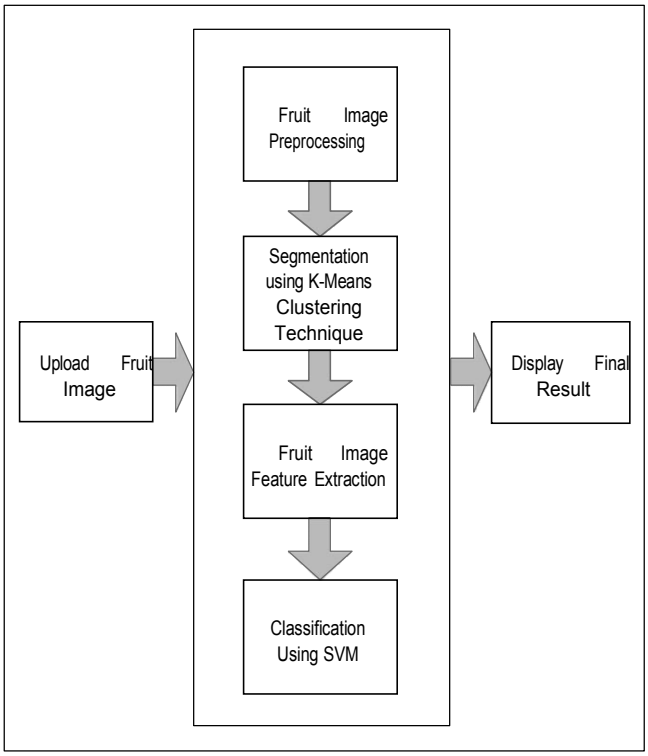

Fig 2. Proposed System Architecture

V. MATHEMATICAL MODEL

X = Input of the program.
Input should be Image File.
Y = Output of the program.File will be allocated.
Then the further processing will done andfinally when we request for result,
then accurate result will provided.
X, Y U
Let U be the Set of System.
U= {Client, I, K, S, D}
Where, Client, I, K, S, D are the elements of the set.Client= User
I=Image File
K= K-Means Clustering.
S= Support Vector Machine.D=Check for duplicate file

ALGORITHM USED:

K-MEANS CLUSTERING

Input: Dataset (Pomegranate fruit image), K number of desired clusters. Output: K set of clusters.
1. Initialize the number of cluster k, and also pick initial centroid randomly.
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.

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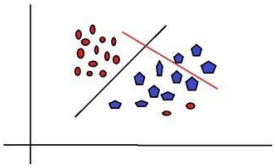
3. For each cluster, the new centroid is computed andeach seed value is now replaced by the respective cluster centroid.
5. Euclidean distance from an object to each cluster iscalculated, and the image is allotted to the cluster with the smallest Euclidean distance. This process will be continue until image is in same cluster at every iteration.

SUPPORT VECTOR MACHINE (SVM)

1. It plots data point in N-dimensional space
2. Uses hyper plane to classification
3. Supervised Machine Learning algorithm
4. It uses Margin distance
5. Consider following scenario

SVM uses the different hyper-plane which separates two different classes better. It is accurately classify the give data into different hyper-plane . if there have multiple hyper- plane which accurately classify all the data set the we need to calculate margin distance. It also calculates the margin distance. It is maximum distance between data set and hyper-plane. Whoever be hyper-plane has maximum margindistance that take as accurate hyper-plane to classify the data set.



SVM accurately classify all the data set correctly as compareto all other algorithm. SVM uses the outlier concepts which mean when hyper-plane accurately classify data into different class but if some part of data contain little be another elements of different class then SVM classify that part as outlier.

VI. CONCLUSION

An image processing based solution is proposed and evaluated in this paper for the detection and classification of fruit diseases. The proposed approach is composed of mainly three steps. In the first step image segmentation is performed using K-Means clustering technique. In the second step features are extracted. In the third step training and classification are performed on a SVM. It would also promote Indian Farmers to do smart farming which helps to take time to time decisions which also save time and reduce loss of fruit due to diseases. The leading objective of our paper is to enhance the value of fruit disease detection.

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