International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 03 | Mar-2016 www.irjet.net p-ISSN: 2395-0072

Detection and Classification of Fruit Disease : A Review

Mrunali Desai[1], Ashish Kumar Jain[2], Nilesh Kumar Jain[3], Karan Jethwa[4]

[1]*Professor, Computer Engineering, K.J. Somaiya Institute of Engineering And Information Technology, MH, India*
[2]*Student, Computer Engineering, K.J. Somaiya Institute of Engineering And Information Technology, MH, India*
[3] *Student, Computer Engineering, K.J. Somaiya Institute of Engineering And Information Technology, MH, India*
[4] *Student, Computer Engineering, K.J. Somaiya Institute of Engineering And Information Technology, MH, India*

Abstract -*Diseases in fruit cause catastrophic problem in economic losses and production in agricultural industry worldwide. The main aim of this paper is to provide literature survey which gives an idea that what has been done till now and what is the scope of current research for the image categorization problems and present a solution to farmers for detecting and classifying diseases present in fruit which are experimentally validated. Image processing based approach composed of the following steps is used; in the first step the proposed approach would be using clustering technique for image segmentation which is followed by extraction of some features from the segmented image and finally images are classified into one of the classes.*

Key Words: *Image Acquisition, Pre-processing, Segmentation, feature extraction, feature training, feature matching.*

I. INTRODUCTION

Defective food products have a common occurrence on the shelves of stores. Even after paying a lump sum amount customers are dissatisfied with the products they buy. One of such products are the fruits and vegetables. To a human eye they may appear healthy and fresh but only after cutting or eating it, the customers know its quality. This also affects the profitability for the producers. Thus, there is a need to have applications which identify the quality, defects of fruits and vegetables so that the customers get only the best quality product for the money they pay. The quality , defects of fruits are checked using technologies like MRI ,x- ray imaging etc which are costly for farmers to afford, occupy large space , users need to have scientific knowledge to use and analyze the results , and have harmful effects on the specimen used for research. Thus, they cannot be used by everyone and on each and every product. Some disease also infects other areas of the tree causing diseases of twigs, leaves, and branches. Every disease occurring in fruit creates a particular texture or specific colored spot. We can use these features for detection of diseases in the fruit. 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 is a fungal disease causing a brown or black, spreading rot in fruit that may be covered by a red halo. Apple blotch is a fungal disease and appears on the surface which can vary in size from small, dark spots to large blotches that can cover much of the fruit surface.

II. LITERATURE REVIEW

Recently, a lot of activity in the area of fruit disease detection can be seen in which defect segmentation of fruits are performed using simple threshold approach[1],[2],. An adaptive threshold method for defect segmentation on apples is presented in [3]. Pixels are classified into different classes using different classification methods. Kleynen et al. [4] is based on Bayesian classification where defected or healthy pixels are classified by comparing them with pre-calculated model.

In [5], Ojala et al. uses uniform local binary pattern to classify static as well as dynamic textures. Local binary pattern is very efficient feature to define local image pattern. Recent development in agriculture technology has led to a demand of automated non-destructive methods of fruit disease detection. It is desirable that the fruit disease detection tool should accurately classify particular disease. The disease monitoring approaches like spectroscopic and imaging techniques have been used to detect diseases. Current research activities are towards the development of such technologies that can be used for large-scale detection of disease in fruits.

Some of the spectroscopic and imaging techniques that are used for the detection of diseases are: fluorescence imaging used by Bravo et al. [6]; Moshou et al. [7]; Chaerle et al. [8], multispectral or hyperspectral imaging used by Moshou et al. [9]; Shafri and Hamdan [10]; Qin et al. [11], infrared spectroscopy used by Spinelli et al. [12]; Purcell

et al. [13], fluorescence spectroscopy used by Marcassa et al. [14]; Belasque et al. [15]; Lins et al. [16], visible/multiband spectroscopy used by Yang et al. [17]; Delalieux et al. [18]; Chen et al. [19], and nuclear magnetic resonance (NMR) spectroscopy used by Choi et al. [20]. Hahn [21] reviewed multiple methods (sensors and algorithms) for pathogen detection, with special emphasis on postharvest diseases. Several techniques for detecting diseases is reviewed in [22] such as, Molecular techniques, Spectroscopic techniques (Fluorescence spectroscopy and Visible and infrared spectroscopy), and Imaging techniques (Fluorescence imaging and Hyper-spectral imaging).

In [7], a ground-based real-time remote sensing system for detecting diseases in arable crops in an early stage of disease development is developed. The authors have used an imaging spectrograph with hyper-spectral reflection images of infected and simultaneously they have also used multi-spectral fluorescence images using UV-blue excitation on the same specimen.

In [8], the authors have used fluorescence imaging and compared it to the visual development of diseases of tobacco mosaic virus infection in resistant tobacco. Large scale plantation of oil palm trees requires on-time detection of diseases as the ganoderma basal stem rot disease was present in more than in Peninsular Malaysia 50% of the oil palm plantations. To deal with this problem, airborne hyperspectral imagery offers a better solution [10] in order to detect and map the oil palm trees that were affected by the disease on time. Citrus canker is among the most devastating diseases that affect marketability of citrus crops. In [11], a hyper-spectral imaging approach is developed for detecting canker lesions on citrus fruit and hyper-spectral imaging system is developed for acquiring reflectance images from citrus samples in the spectral region from 450 to 930 nm.

In [13], the authors have investigated the power of NIR spectroscopy as an alternative to rate clones of sugarcane leaf spectra from direct measurement and examined its potential using a calibration model to successfully predict resistance ratings based on a chemometrics approach such as partial least squares. Marcassa et al. [14] have applied laser-induced fluorescence spectroscopy to investigate biological processes in orange trees. They have investigated water stress and Citrus Canker, which is a disease produced by the Xanthomonas axonopodis pv. citri

Lins et al. [16] have developed an optical technique to detect and diagnose citrus canker in citrus plants with a portable field spectrometer unit. In [18], the authors have investigated the use of hyper-spectral methods caused by apple scab for early detection of plant stress to move towards more reduced and efficient application of fertilizers, pesticides or other crop management treatments for the apple orchards.

III. PROPOSED SYSTEM

The steps of the proposed system are shown in the Fig.1.

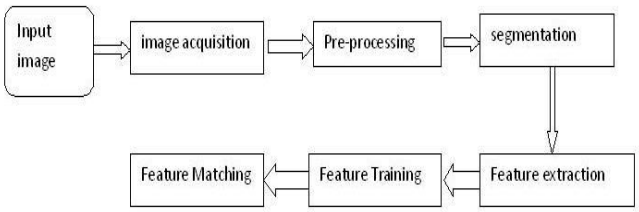

Fig -1: Proposed System (Flow Chart)

Image Acquisition: The first stage of any image processing based approach is the image acquisition stage. It is a process in which image is retrieved from some source, usually a hardware based source. The source can be anything from webcam to a mobile camera. After acquiring the image, various methods of processing can be applied to the image to perform the many different vision tasks required.

Pre–Processing: Images obtained from image acquisition stage cannot be used directly for identifying of disease due to presence of some factors such as unwanted background, poor resolution of camera etc. The main aim of pre-processing is to eliminate unwanted distortion and enhance some image features for further processing. Various filtering techniques are used in this stage for faster evaluation.

Segmentation: Image Segmentation is used to classify an image into meaningful region. There are many types of segmentation techniques such as Clustering based segmentation, Region based segmentation, Edge based segmentation, Threshold based segmentation etc. Clustering based image segmentation is suitable for our proposed approach because image can be partitioned into clusters in which one cluster can contain the majority of the diseased part of the image. Here K-Means clustering algorithm [23] developed by J. MacQueen (1967) can be used for the image segmentation.

Feature Extraction: Feature extraction involves reducing the redundant input data and transforming it into a reduced set of features also called as feature vector. The extracted features contains only relevant information, so that the desired task of disease classification can be performed using limited representation instead of using complete initial data. Feature extraction techniques like Global Color Histogram, Color Coherence Vector, Local

Binary Pattern, and Complete Local Binary Pattern can be used.

Feature Training: In Feature training, based on characteristic properties of image feature extracted in previous step a unique description of each classification category, i.e. training class, is created. The description of training classes is an important component of disease classification process. Feature training can be done using supervised or unsupervised approach. The supervised approach is based on an a priori knowledge of probability distribution functions which extracts class descriptors. Unsupervised approach relies on clustering algorithms to automatically segment the training data into prototype classes.

Feature Matching: Feature matching methods essentially consist of identifying features in images that can be matched with corresponding features in the other images from which a transformation model can be estimated. Correlation method can be used for feature matching. In this method the extracted features are correlated with one another and we get a specific training class to which that particular image belongs.

3. CONCLUSIONS

This paper provides a detailed literature review and gives an idea that what has been done till now and what is the scope of current research for the image categorization problems. Image processing based approach composed of the following steps is used; in the first step the proposed approach would be using clustering technique for image segmentation which is followed by extraction of some features from the segmented image and finally images are classified into one of the classes

REFERENCES

[1] Q. Li, M. Wang and W. Gu, "Computer Vision Based System for Apple Surface Defect Detection," Computers and Electronics in Agriculture, vol. 36, pp. 215-223, Nov. 2002.

[2] P. M. Mehl, K. Chao, M. Kim and Y. R. Chen, "Detection of Defects on Selected Apple Cultivars using Hyperspectral and Multispectral Image Analysis," Applied Engineering in Agriculture, vol. 18, pp. 219-226, 2002.

[3] M. S. Kim, A. M. Lefcourt, Y. R. Chen and Y. Tao, "Automated Detection of Fecal Contamination of Apples Based on Multispectral Fluorescence Image Fusion," Journal of food engineering, vol. 71, pp. 85-91, 2005.

[4] O. Kleynen, V. Leemans and M. F. Destain, "Development of a Multi- Spectral Vision System for the Detection of Defects on Apples," Journal of Food Engineering, vol. 69, pp. 41-49, 2005.

[5] T. Ojala, M. Pietikäinen and T. T. Mäenpää, "Multiresolution Gray-Scale and Rotation Invariant Texture Classification with Local Binary Pattern," IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI), vol. 24, no. 7, pp. 971-987, 2002.

[6] C. Bravo, D. Moshou, R. Oberti, J. West, A. McCartney, L. Bodria and H. Ramon, "Foliar Disease Detection in the Field using Optical Sensor Fusion," Agricultural Engineering International: the CIGR Journal of Scientific Research and Development, vol. 6, pp. 1-14, December 2004.

[7] D. Moshou, C. Bravo, R. Oberti, J. West, L. Bodria, A. McCartney and H. Ramon, "Plant Disease Detection Based on Data Fusion of Hyper-Spectral and Multi-Spectral Fluorescence Imaging using Kohonen Maps," Real-Time Imaging, vol. 11, no. 2, pp. 75-83, 2005.

[8] L. Chaerle, S. Lenk, D. Hagenbeek, C. Buschmann and D. V. D. Straeten, "Multicolor Fluorescence Imaging for Early Detection of the Hypersensitive Reaction to Tobacco Mosaic Virus," Journal of Plant Physiology, vol. 164, no. 3, 253-262, 2007.

[9] D. Moshou, C. Bravo, S. Wahlen, J. West, A. McCartney and J. De Baerdemaeker, H. Ramon, "Simultaneous Identification of Plant Stresses and Diseases in Arable Crops using Proximal Optical Sensing and Self- Organising Maps," Precision Agriculture, vol. 7, no. 3, pp. 149-164, 2006.

[10] H. Z. M. Shafri and N. Hamdan, "Hyperspectral Imagery for Mapping Disease Infection in Oil Palm Plantation using Vegetation Indices and Red Edge Techniques," American Journal of Applied Sciences, vol. 6, no. 6, pp. 1031-1035, 2009.

[11] J. Qin, F. Burks, M. A. Ritenour and W. G. Bonn, "Detection of Citrus Canker using Hyper-Spectral Reflectance Imaging with Spectral Information Divergence," Journal of Food Engineering, vol. 93, no. 2, pp. 183-191, 2009.

[12] F. Spinelli, M. Noferini and G. Costa, "Near Infrared Spectroscopy (NIRs): Perspective of Fire Blight Detection in Asymptomatic Plant Material," Proc. 10th International Workshop on Fire Blight, Acta Horticulturae 704, 2006, pp. 87-90.

[13] D. E. Purcell, M.G. O"Shea, R. A. Johnson and S. Kokot, "Near-Infrared Spectroscopy for the Prediction of Disease Rating for Fiji Leaf Gall in Sugarcane Clones," Applied Spectroscopy, vol. 63, no.4, pp. 450-457, 2009.

[14] L. G. Marcassa, M. C. G. Gasparoto, J. Belasque Junior, E. C. Lins, F. Dias Nunes and V. S. Bagnato, "Fluorescence Spectroscopy Applied to Orange Trees," Laser Physics, vol. 16, no. 5, pp. 884-888, 2006.

[15] L. Belasque, M. C. G. Gasparoto and L. G. Marcassa, "Detection of Mechanical and Disease Stresses in Citrus Plants by Fluorescence Spectroscopy," Applied Optics, vol. 7, no. 11, pp. 1922-1926, 2008.

[16] E. C. Lins, J. Belasque Junior and L. G. Marcassa, "Detection of Citrus Canker in Citrus Plants using Laser Induced Fluorescence Spectroscopy," Precision Agriculture, vol. 10, pp. 319-330, 2009.

[17] C. M. Yang, C. H. Cheng and R. K. Chen, "Changes in Spectral Characteristics of Rice Canopy Infested with Brown Planthopper and Leaffolder," Crop Science, vol. 47, pp. 329-335, 2007.
[18] S. Delalieux, J. van Aardt, W. Keulemans, E. Schrevens and P. Coppin, "Detection of Biotic Stress (Venturia Inaequalis) in Apple Trees using Hyper-Spectral Data: Non-Parametric Statistical Approaches and Physiological Implications," European Journal of Agronomy, vol. 27, no. 1, pp. 130-143, 2007.
[19] B. Chen, K. Wang, S. Li, J. Wang, J. Bai, C. Xiao and J. Lai, "Spectrum Characteristics of Cotton Canopy Infected with Verticillium Wilt and Inversion of Severity Level," Computer and Computing Technologies in Agriculture, vol. 2, pp. 1169-1180, 2008.
[20] Y. H. Choi, E. C. Tapias, H. K. Kim, A. W. M. Lefeber, C. Erkelens, J. T. J. Verhoeven, J. Brzin, J. Zel and R. Verpoorte, "Metabolic Discrimination of Catharanthus Roseus Leaves Infected by Phytoplasma using 1H-NMR Spectroscopy and Multivariate Data Analysis," Plant Physiology, vol. 135, pp. 2398-2410, 2004.
[21] F. Hahn, "Actual Pathogen Detection: Sensors and Algorithms—A Review," Algorithms, vol. 2, no. 1, pp. 301-338, 2009.
[22] S. Sankarana, A. Mishraa, R. Ehsania and C. Davisb, "A Review of Advanced Techniques for Detecting Plant Diseases" Computers and Electronics in Agriculture, vol. 72, pp. 1-13, 2010.
[23] J. MacQueen, "Some methods for classification and analysis of multivariate observations," In L. M. LeCam and J. Neyman, editors, Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability, 1967, vol. 1, pp. 281—297, University of California Press.