A Review on Automatic Detection Techniques of Infected Fruits

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Abstract— **In this paper we have discuss recognition techniques of automatic detection of normal and infected fruits. Nowadays computer science is getting more and more involved in agricultural and food science. Plenty fruits and vegetables are imported from the other nations such as oranges, apples etc. Manual identification of defected fruit is very time consuming. here work presents defect segmentation of fruits based on color features. In this paper we discussed the reviews of image processing and the general framework of image processing using different methods for automatic detection of fruits.**

Index Terms— **Artificial Neural Networks,Computer vision, Feature selection,Image Processing, Image segmentation .**

I. INTRODUCTION

In todays world for economic growth of nation, fruit industry contributes a major part, but because of lack of proper cultivation and maintenance, lack of knowledge of preservation and quick quality evaluation techniques, manual inspection, there has been a decrease in production of good quality fruits and very high post harvest losses in handling and processing. In such case there is the demand of a rapid, economic, consistent and nod-destructive inspection method to get rid of problems like rising labour costs, shortage of skilled workers. [1]. As we know fruits exist everywhere we live. As diseases of the fruits are inevitable, detecting disease plays an important role in the field of Agriculture and fruit industry. As it reduces quantity and degrades quality of the agricultural products. this require careful diagnosis and detection. for this we require automation which can reduce the costs by promoting production efficiency. Automatic fruit grading and sorting requires the implementation of computer vision systems[2]. In this paper we are going through an overview of detection of different fruits using different techniques.

II. HISTORY

For classifying and detecting apple diseases using machine vision there are many researchers who made considerable efforts. And Several approaches like monochrome-colored near infrared imaging, and local-global methods have been tried[3]. It include computerized method from magnetic resonance images by threshold technique. The algorithm was only able to discriminate between all-bruised and non-bruised apples and was not applicable to on-line detection[3],[39].Other work used a thinning algorithm to discriminate between stem and body of the apples on monochromatic images. However the task of classifying the calyx and defected parts real-time was missing.[3],[40].another work presented the 'flooding' algorithm for initial segmentation and 'snakes' algorithm for refining the boundary of the blemishes on the monochromatic images of apples. They applied both median and gaussian filters to remove impulsive noise and smooth small features.[3],[41]. the recent work included color (red, green, and blue) grading of apples by neural network using reflectance characteristics and concluded that multi-layer back propagation (MLBP) method gave the best recognition rates[3],[42]. next reaserches used a pixel-wise comparison method between the chromatic (rgb) values of the related pixel and the color reference model. The local and global approaches of comparison were effective, but further research was needed.researchers then introdused automated rule-based system by near-infrared images to classify 'Red Delicious' apples as defected or not. Detection techniques are also used to separate anthracnose affected lesion areas from normal area and graded based on percentage of affected area in many fruits[6]. One of the method is using ANN which has been a successful tool in predicting food properties of dairy products, fruits, vegetables and meat products[7]. further introduced a system where three different sensors (a vision system, a near-infrared spectrophotometer and an electronic nose system) are combined by using ANN for non-destructive detection quality [8].

III. METHODS USED FOR DETECTION OF INFECTED F`RUIT

A. Automated machine vision

The inspection and evaluation tasks are done manually in earlier it results in subjective, inconsistent, unreliable and also differs from experts to experts. The primary and major disadvantage of manual sorting are much manpower required, excessive labour power and strength, low production, standard of grading is challenging to carry out and grading precision insecure. hence machine vision based system has been introduced. Machine vision refers to visual data that can be processed by a computer, including imaging in Gamma ray, imaging in X-ray, imaging in UV band, imaging in visible band and IR band, imaging in Microwave band and imaging

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in Radio band, line or spot perception of brightness and colour, time-varying optical signals.[18] Machine vision includes several processes. Images are acquired with a physical image sensor and computing hardware and software are used to analyse the images with the objective of performing a predefined visual task[26]. Based on image processing and analysis, machine vision is a novel approach for recognizing objects and extracting quantitative information from digital images[28].

Components of machine vision
Charge-coupled-device (CCD) camera
Computer disk/ tape drives
Computer hardware and software
Cables and software
Video monitor

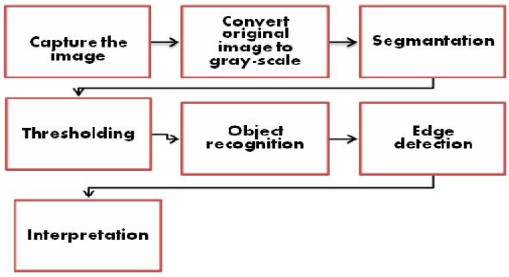

Fig. 1. Block diagram of general fruit detection methodology

B. Image Processing

Image pre-processing is the name for operations on images at the lowest level of abstraction whose aim is an improvement of the image data that suppress undesired distortions or enhances some image features important for further processing and analysis task. It does not increase image information content. Neighboring pixels corresponding to one real object have the same or similar brightness value. In many systems image pre-processing methods are applied to the captured image which are stored in image database[9].Brendon J. Woodford , Nikola K. Kasabov and C.Howard Wearing in paper named "Fruit Image Analysis using Wavelets"[19] proposed wavelet based image processing technique and neural network .Fast wavelet transform with special set of Doubenchies wavelet was used to extract the important features. To retrieve the related images, the search used two steps. The first step matches the images by comparing the standard deviations for the three color components. In the second step, a weighted version of the Euclidean distance between the feature coefficients of an image selected in the first step and those of the querying image is calculated and the images with the smallest distances are selected and sorted as matching images to the query. Principal component transform (PC) and minimum noise fraction transform (MNF) are two commonly used techniques for extracting useful features from hyperspectral images. Both techniques are intended to maximize image features with a minimal number of independent components

through orthogonal transformation of the original image data[11]. In general fruit length obtained with image analysis was significantly greater than that recorded with a stereomicroscopic. Advantages of image processing are the high amount of fruit parameters obtained with one single measurement, the minimization of human errors ,the reduction of time needed to obtain large data sets concerning fruit trait variability [19].

C. Image Segmentation

Image segmentation algorithms development has drawn extensive and consistent attention, relatively A research has been done on segmentation evaluation. As we know most evaluation methods are either subjective,or tied to specific applications and Some objective evaluation methods. In supervised objective evaluation method a manually-segmented reference image is used while in unsupervised objective evaluation the quality score is based solely on the segmented image[14] .We can say segmentation of the image is nothing but pixel classification. Image segmentation is important to separate the object and background clear regardless the image has blur boundary. The proposed improved bacterial foraging algorithm is implemented on the input image[22].It has an importance in image analysis and pattern recognition. It has applications in many fields like Analysis of Remotely Sensed Image, Medical Science, Traffic System Monitoring, and Fingerprint Recognition and so on. Image segmentation methods are based on two fundamental properties of the intensity values of image pixels: 1.similarity in which the concept is to partition the image into several different regions such that the image pixels belonging to a region are similar according to a set of predefined criteria and 2.discontinuity in this category, the concept of partition an image on the basis of abrupt changes in the intensity values is used. An example of this category is Edge detection which is similar to the boundary extraction. Researchers have been introduced many segmentation methods which can be broadly classified into six categories[5]:

a. Histogram based Method

Computationally this is very efficient when compared to other image segmentation techniques as it usually require only a single pass through the image pixels. In this technique, a histogram is calculated from all of the image pixels, and the peaks and valleys are detected in the histogram. Now the image pixels between two consecutive peaks can be considered to a single cluster. Disadvantages of this method are it is not able to categorize when the image has no clear gray level histogram peak. and the continuity of the segmented image regions cannot be ensured.

b. *Edge Detection*

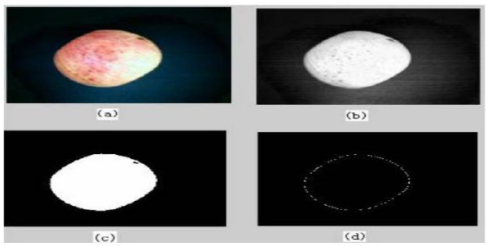

Fig. 2 Processing the fruit image (a) original image, (b) gray scale image (c) diversion image (d) tracking edge

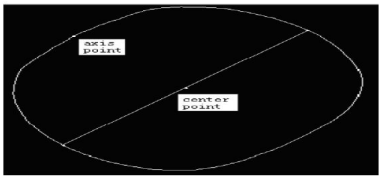

Fig. 3: Detection of fruit axis point and centre point of location.

It is very widely used technique in the image segmentation problems. It based on the the detection of points considering abrupt changes at gray levels. The above figure shows the edge detection of mango fruit[17]. A disadvantage of this method is that it doesn't work well when there are many edges in the image because in that case the segmentation technique produces an over segmented output, and it cannot easily identify a boundary or closed curve. For improving efficiency of this approach, it should identify the global edges and these edges have to be continuous.

c. Neural Network based segmentation methods

This method relies on processing small regions of an image using a neural networker a set of different artificial neural networks. After this, the decision-making method marks the regions of an image on the basis of the category recognized by the artificial neural network. Kohonen self organizing map is a type of network designed especially for such type of problems. To detect tomatoes, research analyzed the roundness and detected deformed tomatoes by applying the variation of fruit's diameter. and Genetic Algorithm (GA) trained artificial neural network[23].

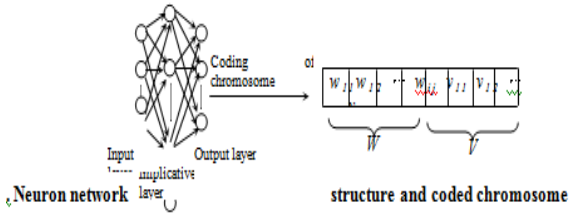

Fig.4.Determination of the genetic encoding scheme

The first step for determination of genetic algorithm scheme is when GA is applied, is the determination of a genetic encoding scheme, namely to denote each possible point in the problem's search space as a characteristic string of defined length. This is in order to be sure that GA will not only optimize network configuration but, in the meantime, genetic training will proceed on weight values. In this paper, weight values between each layer of the multi-layer feed-forward neural network are simultaneously coded as one chromosome. Also Partial least squares(PLS) is a well-known linear algorithm was considered the best option in neural network as the PLS algorithm builds a model that describes the relationship between sensor signals and the fruit-quality parameter to be predicted. [24].

d. Physical Model based approach

The physical model based image segmentation technique assumes that for an image, individual regions follow a recurring form of geometrical structure. This type of segmentation methods uses texture feature.

e. Region based methods

This image segmentation method uses the similarity of pixels within a region in an image. Sometimes a hybrid method incorporating the region based and edge based methods have been proved to be very useful for some applications.

f. Clustering (Fuzzy C-means clustering and Kmeans clustering)

The segmentation method using clustering approaches encounters great difficulties when computing the number of clusters that are present in the feature space or extracting the appropriate feature. This type of image segmentation is widely used due to the simplicity of understanding and more accurate result. K-Means clustering works well if the boundaries are well defined[10].Some researchers present work on K-means clustering technique based on color features from the images. Defect segmentation is carried out into two stages. At first, the pixels are clustered based on their color and spatial features, where the clustering process is accomplished. Then the clustered blocks are merged to a specific number of regions. Using this two step procedure, it is possible to increase the computational efficiency avoiding feature extraction for every pixel in the image of fruits[5] .

Using K-Means Clustering

Step 1. Read the input image of defective fruit.

Step 2. In order to remove the image noise and reduce detail levels the Gaussian low-pass filter
(GLPF) smoothing operator is applied.

Step 3. Transform the image from RGB to L*a*b* color space as all of the color information is
present in the a* and b* layers only.

Step 4. Calculate the histograms of the image to decide the number of clusters.

Step 5. Classify colors using K-means clustering in a*b* space, with Euclidean distance to measure
the distance between two colors.

Step 6. Label each pixel in the image from the results of K labeled with its cluster index.

Step 7. Generate different images for each cluster.

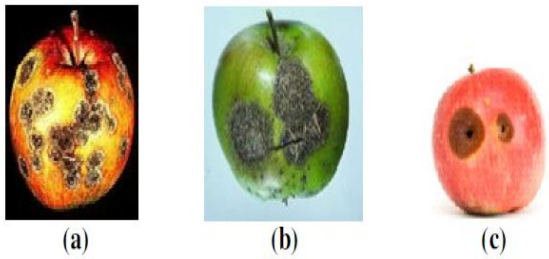

Fig.5. sample images from database

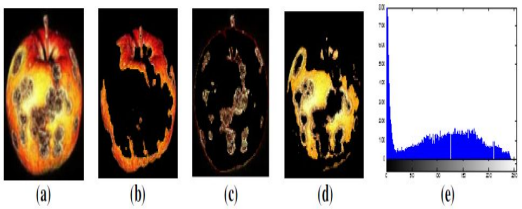

Fig.6.K-means defect segmentation of an apple with scrab. (a) Filtered Image (b) First Cluster(c) Second Cluster (d) Third Cluster (e) Histogram[37].

Fuzzy C-Means
Step 1. Read the input image of defective fruit.
Step 2. In order to remove the image noise and reduce detail levels the Gaussian low
(GLPF) low pass filter smoothing operator is applied.
Step 3. Calculate the histograms of the image to decide the number of clusters.
Step 4. Classify pixel intensities using FCM algorithm (initial value of m=2 and□□□= 0.01) with number of clusters as determined in Step 3.
Step 5. Generate image by allocating different intensity levels for each subclass of the image.[37]

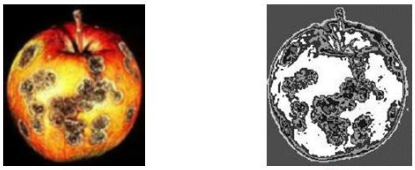
(a) (b)

Fig.7.Fuzzy C-means defect segmentation of an apple with scab.(a) Filtered Image (b) FCM Processed Image

D. Features Extraction

It is a method of capturing visual content of an image. A set of features are extracted in order to allow a classifier to distinguish between defect and non defect pattern. The non defect fruit can be identified on the basis of textural appearance. Extracted features are used in neural classifier to train it for the recognition of particular class either defect or non defect[16].As defined in [21],features are refer to external quality factors.These features are texture,size, shape, intensity and defects. It is interesting to perform background subtraction and focus in the object's description. As Background subtraction is a commonly used for segmenting out objects of interest in a scene. It is a simple technique of subtracting the observed image from the estimated image and thresholding the result to generate the objects of interest. The best channel to perform the background subtraction is the S channel of HSV-stored images as S channel is much less sensitive to lighting variations than any of the RGB color channels[25]. It consist of Classification which is the process of reducing images to usable information[32].

a. Color

In many pattern-recognition and computer-vision applications, color information can be used to enhance image analysis and improve segmentation results as Color images carry much more information than gray-level ones[20].The most commonly used color feature model in image processing is based on the primary spectral components of red (R), green (G) and blue (B). here much of the data that applied as network input were obtained from different color spaces.
a. Separating matrices R, G and B for each picture and calculation of matric mean in two dimensions.
b. Transferring to L*A*B* color space and calculation of L, A and B values distinctly.
c. Transferring to HSV color space using function that was existing for this purpose in MATLAB Image Processing Toolbox and calculation mean of matrices H, S and V in two dimensions.
d. Transferring to HSI color space using function that was written in MATLAB M-File editor and calculation
mean of matrices H, S and I in two dimensions[12].

b. Size

The size is estimated by calculating the area covered by the fruit image. To compute the area, first the fruit image is binarized to separate the fruit image from its background. The number of pixels that cover the fruit image is counted and considered as an estimate of size.fruits are categorize as big, medium and small using the average area and variance relationship: A _ kr2; where A is the average of the normalized area and r2 is the variance obtained from the training data set. If the normalized pixel count in a fruit image is A, and A< A _ kr2; where k is has been experimentally estimated to be 1.45, then the fruit is categorized asB small. If A _ kr2 < A< A þ kr2 then it is categorized as medium; otherwise it is considered big[21].

c. Shape

The another feature used by farmers is shape irregularity as a quality measure. Four shape features which are calculated from an image are area, perimeter, major axis length and minor axis length.Number of pixels in an image is used for determining the area of the image[15]. Fruits having irregular shapes are considered of better quality. It is estimated from the outer profile of the fruit image. The estimation steps are described below[21].

(1) Using an edge tracking operator to estimate the outmost edge points of the fruit image.
(2) Link the outermost edge points to form the outermost profile of the fruit image.
(3) Compute the centroid (x_g, y_g) of the profile.
(4) Starting from the topmost and leftmost point of the profile
and moving clockwise calculate the sequence

$$r(t) = \sqrt{(x_t - x_g) + (y_t - y_g)^2},$$

for t=1, 2, 3, . . ., N, were x_t and y_t are the Cartesian coordinates of the profile at profile boundary time t,
and N is the total number of points in the profile.
(5) Compute the Fourier coefficients of r(t)

$$a_n = \sum_{t=1}^{N} r(t) e^{\frac{-2j\pi nt}{N}}$$

The value of the first coefficient was used as the irregularity measure.[21]

d. Intensity

Pixel intensities is a simple available feature useful for pattern classification. Intensity features depends only on individual pixel values. The intensity and its variation inside the fruit images can be measured by features like: median, mode, standard deviation and variance.[16]

e. Defects

These are determined from the color intensity. An estimate of the average brightness and variations in intensity of the bird flicked area were obtained. The average brightness was

thoroughly examined and the bird flicked area size was tracked and estimated. A pixel belongs to the bird flicked area if the brightness of a pixel lies in the interval Ib _ kr2 b; where Ib is the average brightness of the pixels and r2b is the variance in the bird flicked area, and k is an experimentally determined constant. The bruises are estimated from the shape as they generally deform the shape by tearing the fruit. If observed finding an accurate estimate of bruises is an extremely difficult task[21].

CONCLUSION AND FUTURE SCOPE

This review paper shows the detection techniques for detecting normal and defected fruits as well.using artificial neural network is the best approach for quality analysis of fruits and it has a great scope in other food analysis field too.

REFERENCES

[1] Jasmeen Gill, Dr.Parvinder Singh Sandhu, and Dr.Tejwant Singh,“ A Review of Automatic Fruit Classificationusing soft computing techniqes”, International Conference on Computer, PP. 15-16,2014 .

[2] Bindu Tiger, Toran Verma, “Identification and Classification of Normal and Infected Apples using Neural Network”, International Journal of Science and Research,Volume-2,ISSN 2319-7064,2013.

[3] Devrim Unay, Bernard Gosselin, “Apple Defect Detection and Quality Classification with MLP-Neural Networks”, TCTS Laboratory,volume no.1.

[4] Carsten Peterson and Thorsteinn Rognvaldsson, “an introduction to artificial neural network”,Department of theoretical physics.

[5] Shiv Ram Dubey, Pushkar Dixit, Nishant Singh, Jay Prakash Gupta, “Infected Fruit Part Detection using K-Means Clustering Segmentation Technique”, International Journal of Artificial Intelligence and Interactive Multimedia, Vol. 2, No. 2,2013.

[6] Jagadeesh Devdas Pujari, Rajesh Yakkundimath and Abdulmunaf Syedhusain Byadgi, “ Grading and Classification of Anthracnose Fungal Disease of Fruits based on Statistical Texture Features”, International Journal of Advanced Science and Technology Vol. 52, March 2013 .

[7] Sumit goyal, “ Artificial neural networks (ANNs) in food science – A review ” International Journal of Scientific World, PP

[8] Zou Xiaobo and Zhao Jiewen, “Apple quality assessment by fusion three sensors”, Agricultural Product Processing Lab,IEEE ,PP. 7803-9056,2005.

[9] Anand.H.Kulkarni and Ashwin Patil R. K., Applying image processing technique to detect plant diseases”, International Journal of Modern Engineering Research , Vol.2, pp-3661-3664 ,2012.

[10] P.Kavitha and B.Ananthi, “Segmentation Of Unhealty Region Of Plant Leaf Using Image Processing Techniques: A Servey”, IJRET: International Journal of Research in Engineering and Technology , Volume: 03 Issue: 11,Nov-2014 .

[11] R. Lu, “Detection Of Bruises On Apple Using Near Infrared Hyperspectral Imaging ”, American Society of Agricultural Engineers, Vol. 46(2), 2003.

[12] Amir Alipasandi, Hosein Ghaffari,and Saman Zohrabi Alibeyglu, “Classification of three Varieties of Peach Fruit Using Artificial NeuralNetwork Assisted with Image Processing Techniques”, International Journal of Agronomy and Plant Production. Vol., 4 (9), pp.2179-2186, 2013.

[13] Manisha A. Bhange and Prof. H. A. Hingoliwala, “A Review of Image Processing for Pomegranate Disease Detection”, (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 6 (1) ,pp.92-94, 2015.

[14] Hui Zhang , Jason E. Fritts and Sally A. Goldman, “Image segmentation evaluation: A survey of unsupervised methods”, Computer Vision and Image Understanding , 260–280, 2008.

[15] Bhanu Pratap, Navneet Agarwal, Sunil Joshi & Suriti Gupta, “Development of Ann Based Efficient Fruit Recognition Technique”, Global Journal of Computer Science and Technology: C Software & Data Engineering, Volume 14 , 2014.

[16] P.Deepa and Dr.S.N.Geethalakshmi, “A Comparative Analysis of Feature Extraction Methods for Fruit Grading Classifications”, International Journal of Emerging Technologies in Computational and Applied Sciences (IJETCAS), pp.13-138, 2013.

[17] R. Swarn Lakshmi and B. Kanchanadevi, “ A Review on Fruit Grading Systems for Quality Inspection” , International Journal of Computer Science and Mobile Computing, Vol.3 Issue.7, pp. 615-621, july 2014.

[18] Deepika Bajaj1 and Shanu Sharma, “A Survey of Machine Vision Techniques for Fruit Sorting and Grading”, International Journal of Engineering Research & Technology (IJERT),Vol. 3 ,July – 2014.

[19] Jayamala K. Patil and Raj Kumar, “Advances In Image Processing For Detection Of Plant Diseases ”, Journal of Advanced Bioinformatics Applications and Research ,vol 2, pp 135-141, June-2011.

[20] Norasyikin Fadilah and Junita Mohamad-Saleh, “Color Feature Extraction of Oil Palm Fresh Fruit Bunch Image for Ripeness Classification”, Applied Computational Science, ISBN: 978-960-474-368-1.

[21] Yousef Al Ohali, “Computer vision based date fruit grading system: Design and implementation”,Journal of King Saud University –Computer and Information Sciences, pp.29-36,2010.

[22] P.Lakshmi Devi and S.Varadarajan , “ Defect Fruit Image Analysis using Advanced Bacterial Foraging Optimizing Algorithm”, IOSR Journal of Computer Engineering (IOSR-JCE) , Volume 14, Issue 1, PP 22-26, Sep. - Oct. 2013 .

[23] Junlong Fang , Shuwen Wang and Changli Zhang , “Application of Genetic Algorithm （GA） Trained Artificial Neural Network to Identify Tomatoes with Physiological Diseases ”,Northeast Agricultural University.

[24] Jesús Brezmes, Ma. Luisa López Fructuoso, Eduard Llobet, Xavier Vilanova, Inmaculada Recasens, Jorge Orts,Guillermo Saiz, and Xavier Correig , “Evaluation of an Electronic Nose to Assess Fruit Ripeness”, IEEE sensors journal, Vol. 5, No. 1, February 2005.

[25] S.Arivazhagan, R.Newlin Shebiah, S.Selva Nidhyanandhan and L.Ganesan, “Fruit Recognition using Color and Texture Features” , Journal of Emerging Trends in Computing and Information Sciences , Vol. 1, No. 2, Oct 2010 .

[26] Tadhg Brosnan and Da-Wen Sun , “Improving quality inspection of food products by computer vision—a review”, Journal of Food Engineering 61, pp. 3–16, 2004.

[27] P. Vimala Devi and K.Vijayarekha , “Machine Vision Applications To Locate Fruits,Detect Defects And Remove Noise: A Review”, Rasayan J. Chem, Vol. 7, No.1, pp.104-113, January – March-2014.

[28] Chetna V. Maheshwari , "Machine Vision Technology For Oryza Sativa L.(Rice)", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering,Vol. 2, Issue 7, July 2013 .
[29] A.E.Watada, "Methods For Determining Quality Of Fruits And Vegetables", Quality of Fruits And Vegetables Pre And Post Harvest Factors And Technology, 1995.
[30] H.K. Purwadaria, IW. Budiastra, A. Rejo and D.A. Nasution, " Neural Network Model for Predicting and Classifying Exotic Tropical Fruits Based on Its Maturity and Ripeness", Bogor Agricultural University (IPB).
[31] Lily Amelia and Muhammad Ridwan Andi Purnomo , "Palm Oil Fruit Classification Using Component Analysis Approach", Department of Industrial Engineering.
[32] Sanjay Chaudhary and Bhavesh Prajapati , " Quality Analysis and Classification of Bananas", International Journal of Advanced Research in Computer Science and Software Engineering , Volume 4, Issue 1, January 2014.
[33] Leemans, V., Destain, M.-F. and Magein, H., "Quality Fruit Grading by Colour Machine Vision: Defect Recognition", Acta horticulturae , pp. 405-412, 2000.
[34] Sapan Naik and Dr. Bankim Patel, "Usage of Image Processing and Machine Learning Techniques in Agriculture - Fruit Sorting", CSI Communications, october 2013.
[35] A. S. Simões; A.H. Reali Costa; A. R. Hirakawa and A. M. Saraiva , "Applying neural networks to automated visual fruitsorting", World Congress On Computers In Agricultaral And Natural Resourses.
[36] Elena Guzmán, Vincent Baeten, Juan Antonio Fernández Pierna and José A. García-Mesa, " Using a Visible Vision System for On-Line Determination of Quality Parameters of Olive Fruits", Food and Nutrition Sciences,pp.90-98 ,july 2013.
[37] VaniAshok and Dr. D.S. Vinod, "Using K-Means Cluster And Fuzzy C Means For Defect Segmentation In Fruit", International Journal Of Computer Engineering & Technology (IJCET), Volume 5, Issue 9, pp. 11-19, september 2014.
[38] Miss.Anuradha P. Gawande 1, Prof. S.S. Dhande , "Implementation of fruit Grading System by Image Processing and Data Classifier- A Review", International Journal of Engineering Research and General Science Volume 2, Issue 6, October-November, 2014 .
[39] Zion B.et al, "Detection of bruises in magnetic resonance images of apples", Comp. Elec. Agric., 13,PP.289-299, 1995.
[40] Pla F., Juste F., "A thinning-based algorithm to characterize fruit stems from profile images", Comp. Elec. Agric., 13, PP.301-314, 1995.
[41] Yang Q., Marchant J. A., "Accurate blemish detection with active contour models", Comp. Elec. Agric., 14, PP. 77-89, 1996.
[42] Miller W. M., et al, "Pattern recognition models for spectral reflectance evaluation of apple blemishes", Postharvest Bio. Tech., 14n , PP.11-20, 1998.

NOTE:-COLOUR IMAGES ARE REQUIRED IN FIGURES WHERE SHOWN.

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