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Smart Strike of Fruit Aspect Using SVM Algorithm

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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. 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.**

***Keywords*- Disease detection, identification of fruit name, SVM, gray scale image, image processing using MATLAB.**

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 are expensive 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 to avoid 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 skin color 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 .There are various approaches available such as spectroscopic and imaging technology, applied to achieve better plant disease control 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. 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

1. Image:
An image (from Latin: imago) is an artifact that depicts visual perception, for example a two-dimensional picture, that has a similar appearance to some subject— usually a physical object or a person, thus providing a depiction of it.

Images may be two-dimensional, such as a photograph or screen display, or three-dimensional, such as a statue or hologram. They may be captured by optical devices – such as cameras, mirrors, lenses, telescopes, microscopes, etc. and natural objects and phenomena, such as the human eye or water.

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The word 'image' is also used in the broader sense of any two-dimensional figure such as a map, a graph, a pie chart, or a painting. In this wider sense, images can also be rendered manually, such as by drawing, the art of painting, carving, rendered automatically by printing or computer graphics technology, or developed by a combination of methods, especially in a pseudo-photograph.

A volatile image is one that exists only for a short period of time. This may be a reflection of an object by a mirror, a projection of a camera obscura, or a scene displayed on a cathode ray tube. A fixed image, also called a hard copy, is one that has been recorded on a material object, such as paper or textile by photography or any other digital process.

2. Size of Image:
The size of raster image files is positively correlated with the resolution and images size (number of pixels) and the color depth (bits per pixel). Images can be compressed in various ways, however. A compression algorithm stores either an exact representation or an approximation of the original image in a smaller number of bytes that can be expanded back to its uncompressed form with a corresponding decompression algorithm.

3. Algorithms:
Lossless compression algorithms reduce file size while preserving a perfect copy of the original uncompressed image. Lossless compression generally, but not always, results in larger files than lossy compression. Lossless compression should be used to avoid accumulating stages of re-compression when editing images.

4. Representations:
A digital image is a numeric representation of (normally binary) a two-dimensional image. Depending on whether the image resolution is fixed, it may be of vector or raster type. By itself, the term "digital image" usually refers to raster images or bitmapped images.

Binary images are also called bi-level or two- level. This means that each pixel is stored as a single bit—i.e., a 0 or 1. The names black-and-white, B & W, monochrome or monochromatic are often used for this concept, but may also designate any images that have only one sample per pixel, such as greyscale images. Binary images often arise in digital image processing as masks or as the result of certain operations such as segmentation, thresholding, and dithering.

Some input/output devices, such as laser printers, fax machines, and bilevel computer displays, can only handle bilevel images. Grayscale images are often the result of measuring the intensity of light at each pixel in a single band of the electromagnetic spectrum (e.g. infrared, visible light, ultraviolet, etc.),

In particular, digital image processing is the only practical technology for:
- Classification
- Feature extraction
- Multi-scale signal analysis
- Pattern recognition
- Projection

5. Image Processing:
Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them. It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps.
- Importing the image with optical scanner or by digital photography.
- Analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs.
- Output is the last stage in which result can be altered image or report that is based on image analysis.

Purpose of Image Processing:
The purpose of image processing is divided into 5 groups. They are:
- Visualization - Observe the objects that are not visible.
- Image sharpening and restoration - To create a better image.
- Image retrieval - Seek for the image of interest.
- Measurement of pattern

II. SPECIFICATION

1. Hardware Requirements:
- Processor: Dual core processor 2.6.0 GHZ
- RAM: 1GB
- Hard disk: 160 GB
- Compact Disk: 650 Mb
- Keyboard: Standard keyboard
- Monitor: 15 inch color monitor

2. Software Requirements:
- Operating System : Windows OS
- Tool : MATLAB

3. Software Specification:

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3.1 MATLAB: MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation.

Typical uses include: Math and computation Algorithm development Modeling, simulation, and prototyping Data analysis, exploration, and visualization Scientific and engineering graphics Application development, including graphical user interface building.

The name MATLAB stands for matrix laboratory. MATLAB was originally written to provide easy access to matrix software developed by the LINPACK and EISPACK projects.

Today, MATLAB uses software developed by the LAPACK and ARPACK projects, which together represent the state-of-the-art in software MATLAB has evolved over a period of years with input MATLAB features a family of application-specific solutions called toolboxes. Very important to most users of MATLAB, toolboxes allow you to learn and apply specialized technology.

Toolboxes are comprehensive collections of MATLAB functions (M-files) that extend the MATLAB environment to solve particular classes of problems. Areas in which toolboxes are available include signal processing, control systems, neural networks, fuzzy logic, wavelets, simulation, and many others MATLAB functions:

A MATLAB "function" is a MATLAB program that performs a sequence of operations specified in a text file (called an m-file because it must be saved with a file extension of *.m). A function accepts one or more MATLAB variables as inputs, operates on them in some way, and then returns one or more MATLAB variables .

Some functions are;

- Imread() – Reading the image from the graphics file. A= imread(filename, fmt) reads a grayscale or color image from the file specified by the stringfilename. If the file is not in the current folder, or in a folder on the MATLAB path, specify the full pathname.
- The text string fmt specifies the format of the file by its standard file extension. For example, specify'gif' for Graphics Interchange Format files. To see a list of supported formats, with their file extensions, use the imformats function. If imread cannot find a file named file name, it looks for a file named file name.fmt.
- The return value A is an array containing the image data. If the file contains a grayscale image, A is an M-by- N array. If the file contains a truecolor image, A is an M-by-N-by-3 array. For TIFF files containing color images that use the CMYK color space, A is an M-by-N-by-4 array. The class of A depends on the bits-per-sample of the image data, rounded to the next byte boundary. For example, imread returns 24-bit color data as an array of uint8 data because the sample size for each color component is 8 bits.
- [X, map] = imread(...) reads the indexed image in filename into X and its associated colormap into map. Colormap values in the image file are automatically rescaled into the range [0,1].
- Image- write image to graphics file imwrite (A, file name, fmt) writes the image A to the file specified by filename in the format specified by fmt.
- A can be an M-by-N (grayscale image) or M-by-N-by-3 (truecolor image) array, but it cannot be an empty array. For TIFF files, A can be an M-by-N-by-4 array containing color data that uses the CMYK color space. For GIF files, A can be an M-by-N-by-1-by-P array containing grayscale or indexed images — RGB images are not supported.

3.2 MATLAB Applications.

- The MATLAB Application Program Interface (API). This is a library that allows you to write C and Fortran programs that interact with MATLAB. It include facilities for calling routines from MATLAB (dynamic linking), calling MATLAB as a computational engine, and for reading and writing MAT-files.
- Simulink, a companion program to MATLAB, is an interactive system for simulating nonlinear dynamic systems. It is a graphical mouse-driven program that allows you to model a system by drawing a block diagram on the screen and manipulating it dynamically.

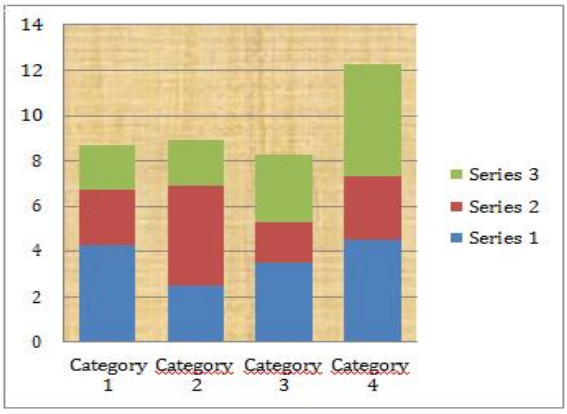

Fig 1. Graphical representation of category&series.

III. METHODOLOGY

1. Modules:

- Image Acquisition and Pre-Processing
- Image Segmentation

2. Image Acquisition and Pre- Processing:

The images were capture using high professional camera (canon DSLR 700D). Those images contain higher amount of image file size. Experiment was conducted in MATLAB (R2016a) with windows platform.

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The captured image is in RGB color space which resizes those images for our research that is 300*400 pixels to reduce computational complexity. To get better result, it is necessary to increase brightness or shining of input image that called as contrast image.

3. Image Segmentation:

Image segmentation is nothing b ut partitioning an image in to some similar features. Segmentation is done using different methods like k-means clustering, converting RGB to HSI model etc. Segmentation using spot detection RGB image is converted to HSI model for segmentation. Using spot detection infected part of fruits can be founded. HSI stands for Hue, Saturation and Intensity. When human view a color object it is describe by its hue, saturation and brightness. K-means clustering the k-means clustering is used for classification of object based on set of features into k number of classes.

The algorithm for K –means Clustering:

- Pick center of K cluster, either randomly or based on some heuristic.
- Assign each pixel in the image to the cluster that minimizes the distance between the pixel and the cluster canter.
- Again compute the cluster centers by averaging all of the pixels in the cluster.
- Repeat steps 2 and 3 until convergence is attained. The infected fruits shows the symptoms of the disease by changing the color of the fruits.

4. Classification:

Image classification analyzes the numerical properties of various image features and organizes data into categories. Classification is a general process related to categorization. Image classification refers to the task of extracting information classes from image. There are two types of classification: supervised and unsupervised. Here we used supervised classification because our target data is known, that is fruits is diseased or healthy represented as 1 and 0.

5. SVM(Support Vector Machine):

SVM is work in high-dimensional spaces seeking an optimal hyper-plane to separate the categories. SVM comprise of a set of related supervised learning methods used for classification and regression. SVM database contains equal images of infected and non-infected, so it is easily to train all the images. Here we used supervised data. SVM is used for decision making. It is suitable to work with high dimensional data. But it can work only with two classes. Using SVM, quality identification of fruits is successfully performed and it gives 95% accuracy.

5.1 Architecture:

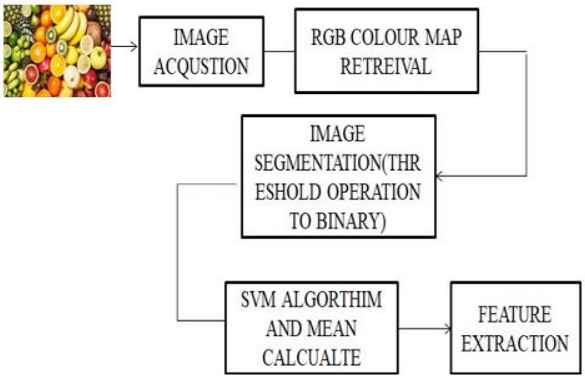

Fig 2. Architecture block diagram .

5.2 Output:

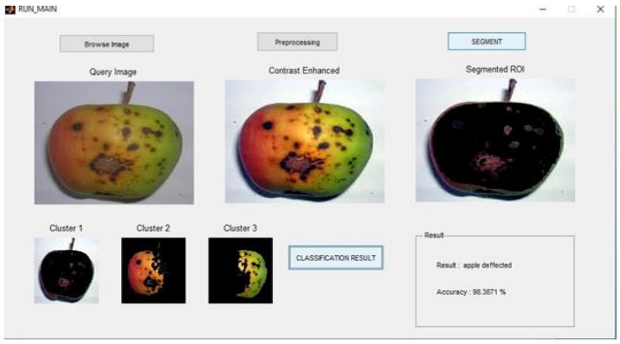

Fig 3. Output for apple.

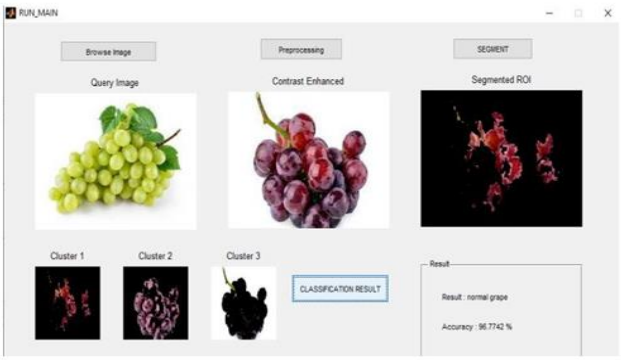

Fig 4. Output for grape .

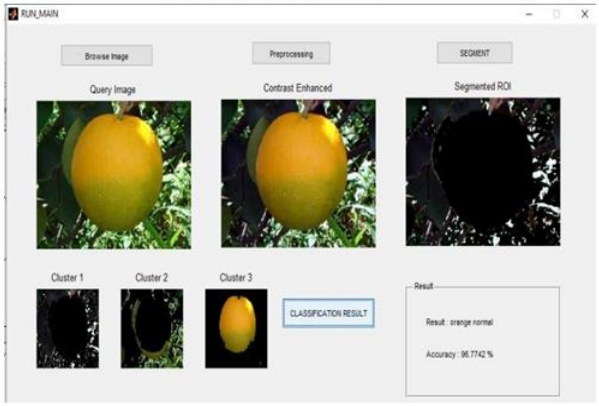

Fig 5. Output for orange.

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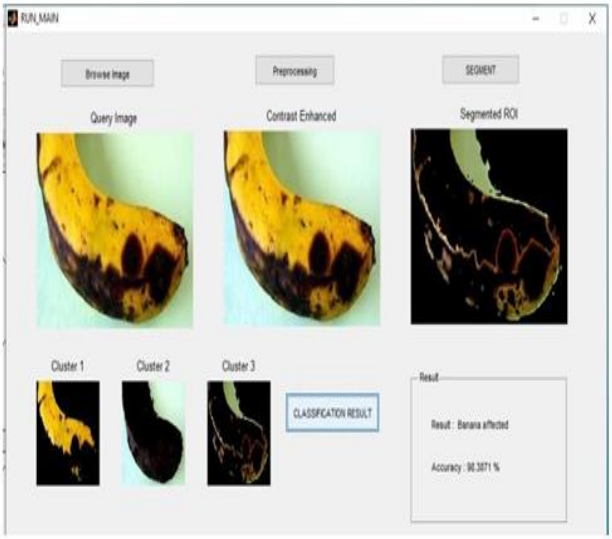

Fig 6. Output for banana.

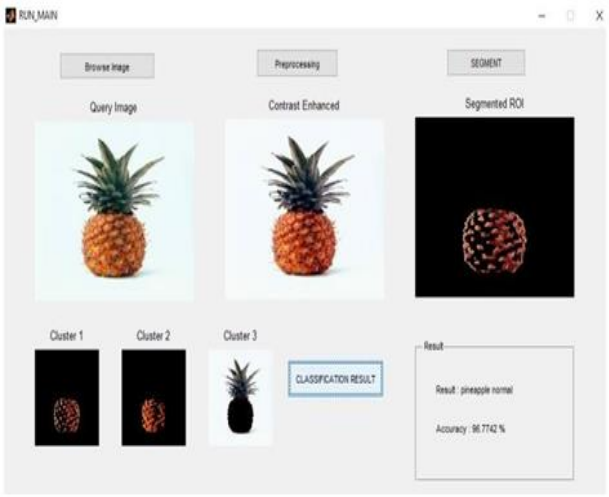

Fig 7. Output for Pineapple.

IV. CONCLUSION

Two relations R-G and R-B were defined to remove the image background. Results showed that removing the image background was successfully done by R-G relation because it could make a high contrast between fruitses and the background. If the overlapped fruitses were not separated, watershed algorithm was effectively improved and could separate touching fruitses correctly. After separating touching fruitses, it would be possible to determine location of each individual fruits. Results showed that region growing algorithm could consider as a useful method at recognizing red fruitses at harvest operations. Overall classification accuracy was 98.38%.

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