SMART FRUIT QUALITY DETECTION USING IOT AND IMAGE PROCESSING TECHNIQUE

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Abstract **-** Diseases in fruit cause devastating problem in economic losses and production in agricultural industry worldwide. 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. Fruits should be quickly and correctly differentiated from their surroundings for the fruit harvesting robot. Edge based and color based detection methods are generally used to segment images of fruits obtained under natural lighting conditions. In this work, Digitized images of mango fruits along with its background were selected from the Internet in order to find a mango in each image and to locate its exact position. We compared the results of Edge based and colored based segmentation results and found that color based segmentation outperforms the edge based segmentation in all aspects. The comparison results are shown in the segmented image results. Accordingly, a new mango detection method is proposed to position the centroid of mangoes

***Index Terms – Image, Support Vector Machine, clustering*, segmentation**

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 quality. There are various approaches available such as spectroscopic and 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. Precision Agriculture helps the farmers to provide with sufficient and economical information and control technology due to the development and disclosure in various fields.

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 identify disease properly by using this proposed work.

II. EXISTING METHOD

In the existing method, a vegetable grading and sorting system based on computer vision and image processing. For this work, tomatoes have been used sample vegetable. A total of 53 images were acquired using own camera setup. Afterward, segmentation using Otsu's method was performed separate the vegetable from the background. The segmented images, thus obtained, were used to extract color and shape features. At last, grading and sorting were performed using back propagation neural network.

In another method, they have classified the fruits in low and high based on the quality of fruits. The hardware it uses is raspberry pi on the MATLAB software. A technique for classifying the flowers by considering their color, contour, and texture. Inception model and transfer learning are applied for the flower classification and retraining their image datasets, using image processing techniques. In this color and texture are used for disease detection. They have used two types of datasets one is the training of images and another one is testing images. For the adjustment of the weight in training images, they used the back propagation. The proposed method has shown an accuracy of 92% and outperformed the existing system.

III. PROPOSED SYSTEM

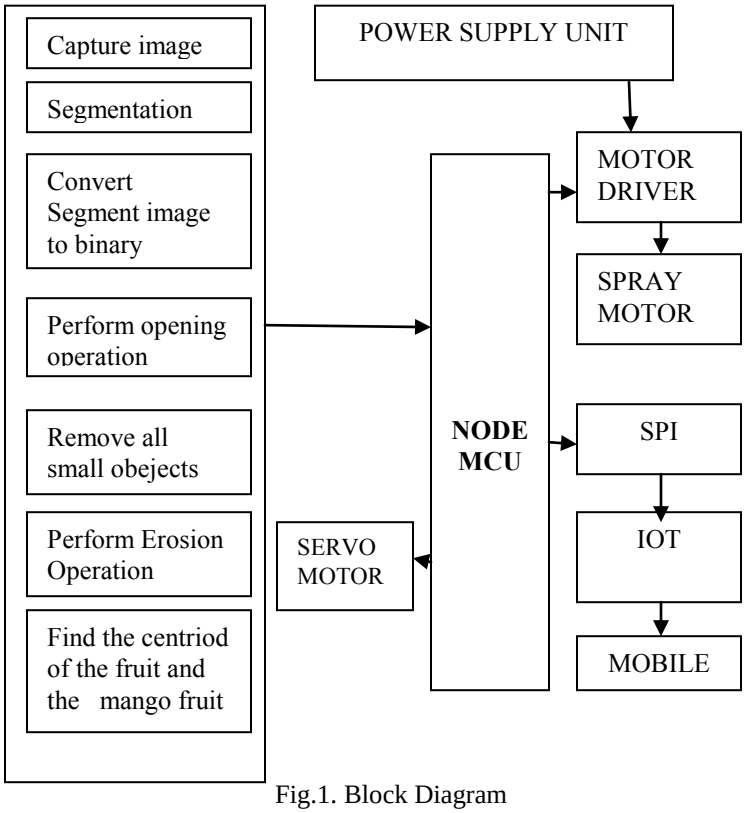

Fig.1. Block Diagram

For the fruit disease classification and quality detection 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.

INPUT IMAGE

The simplest method is to analyse the image. The image taken through the MRI scan. This process is carried out pre-processing. And the images are taken from the hospital.

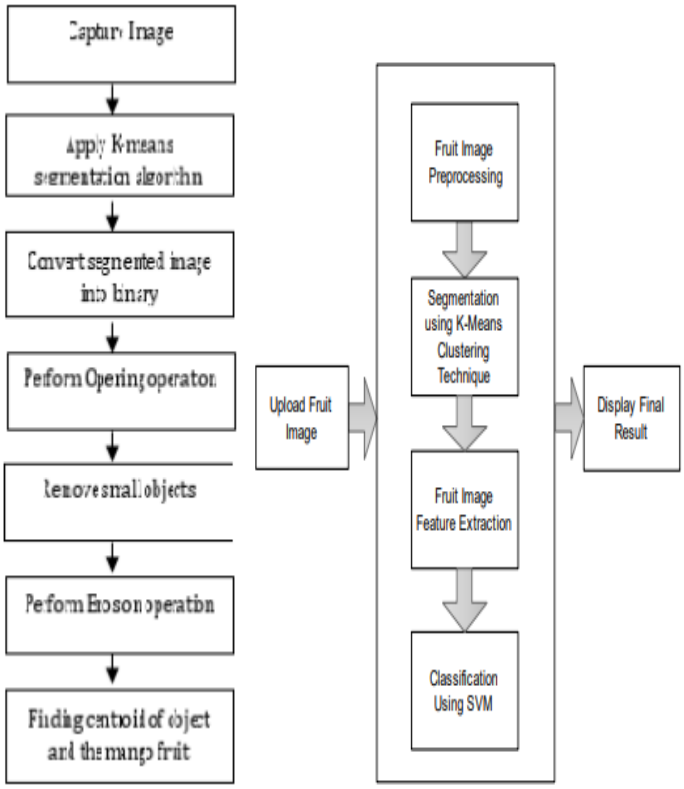

Fig.2. Block Diagram MATLAB PART

A) PREPROCESSING

The first step of proposed method is pre-processing. The images were pre-processed to adjust the colors for better segmentation. It is a process of manipulating an image so that the result is more suitable than the original image for specific application. Pre-processing deals with techniques for increasing the quality of the image and for removal of noise.

B) SEGMENTATION

Image segmentation is considered to be the bottleneck of computer vision. Its goal is to isolate the regions of interest depending on the problem being solved. It is the first step in image analysis and pattern recognition, and it is the most difficult task in image processing, because it determines the quality of final result of the analysis, as the error in this process will be propagated further.

In image processing, segmentation is a basic problem in different fields for example, pattern recognition, scene analysis and image analysis. Image segmentation is the process of diving images into regions according to its characteristic example, color and objects present in the images. This result of image segmentation is in the form of images that are more meaningful, easier to understand and easier to analyse. In order to locate objects and boundaries in image feature extraction of object shape, optical density and texture, surface visualization, image registration and compression image segmentation is used**.**

C) MORPHOLOGICAL OPERATION

Morphological transformations are some simple operations based on the image shape. It is normally performed on binary images. It needs two inputs, one is our original image, second one is called structuring element or kernel which decides the nature of operation. Morphological operations are represented as combinations of erosion, dilation, and simple set-theoretic operations such as the complement of a binary image, intersection and union of two or more binary images. Opening removes small objects from the foreground (usually taken as the bright pixels) of an image, placing them in the background, while closing removes small holes in the foreground, changing small islands of background into foreground. These techniques can also be used to find specific shapes in an image.

IV PROPOSED ALGORITHM

In this step, we perform some necessary operators on the captured image. The captured image of size m*n is converted into square image of size 256*256. During image collection, some noise may be introduced because of camera flash. This noise can affect the detection of disease. To remove unnecessary spot image preprocessing technique is needed. In image pre-processing, image data recorded by sensors on a satellite errors related to geometry and brightness value of the pixel. This errors are connected by using appropriate mathematical models which are either definite.

Image enhancement involves a collection of techniques that are used to improve the visual appearance of an image, or to convert the image to form which is better suited for human. The median, adaptive local filter is used to remove the noise and obtain PSNR value. The adaptive local filter is obtaining high PSNR value so it will be adapt for real time image which is taken.

K-MEANS CLUSTERING ALGORITHM

The image segmentation means that the original image is divided into desired number of parts. Its purpose is to cluster the pixels which have the same features in image. It is the first step of process. There are several methods for this aim. Some of the works are based on the histogram or clustering. In detection of fruit, it is purposed to separate the fruits from background in the image. Here, the method which has been preferred to use is 'k means clustering algorithm', K means clustering algorithm is superior from the other clustering algorithm and is known as unsupervised clustering algorithm [1]. With K-mean,we obtained k different groups from data sets. The distances between every groups are calculated. So, that the groups have to be far away as much as possible from the groups which are not similar, and the members of the particular group are somewhat similar. K means clustering algorithm requires iteration. For this method, firstly, clustering centers are determined and the data is clustered according to those centers. New clustering centers are assigned to previous results. As repetition of these processes is increased, result of the algorithm is close to perfection. In the image processing, k means clustering algorithm provides less number of color sets for current colors of image.

Dataset (Pomegranate fruit image),K number of desired clusters. Output: K set of clusters. 1. 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. 3. For each cluster, the new centroid is computed and each seed value is now replaced by the respective cluster centroid. 4. Euclidean distance from an object to each cluster is calculated, 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.

IMAGE BINARISATION

Segmented image is converted into binary image. Image binarization is the process of converting RGB image into the binary image. A binary image is a digital image that has only two possible values for each pixel. Binary images often arise in digital image processing as masks or as the result of certain operations such as segmentation, thresholding, and dithering x.

MORPHOLOGICAL OPERATIONS

The Binary image is morphologically opened using opening function from Open CV. A disc- shaped structural element is used. Using this disc shaped structural element, removal of small blobs takes place. Here the small regions which do not belong to fruit can be eliminated by using threshold value. If the number of pixels in this region less than

the threshold value, they can be deleted, thus the unwanted region turns black after this operation. The erosion is performed after removal of small objects. The erosion makes the edges sharp. From the above results, we can say that the proposed system was successful in verifying whether an image is forged or not. The proposed system achieved high accuracy using the database. Compare other method it is more accurate.

IV HARDWARE IMPLEMENTION

The hardware unit consists of following units:

1. Node MCU Microcontroller
2. Power Supply Units
3. Spray Motor
4. Servo Motor

Node MCU is a Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espress if Systems, and hardware which is based on the ESP-12 module.

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

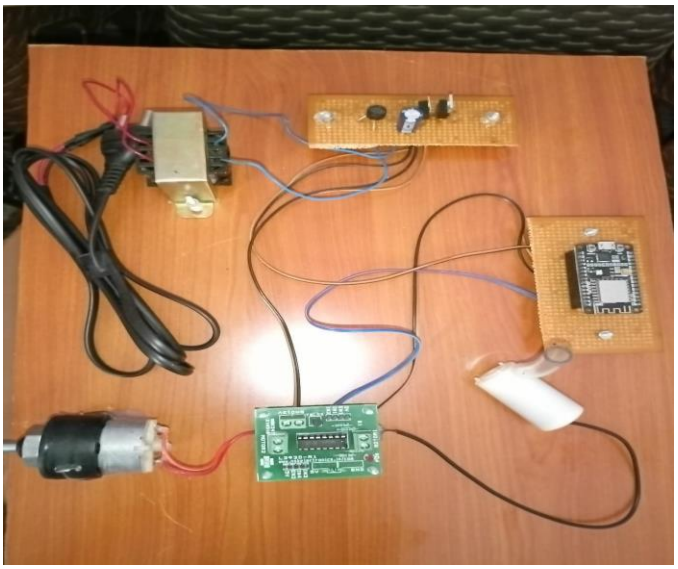

Fig.3. Hardware Implemention

V CONCLUSION

In our system image processing technique was used to identify the defects in mango fruit. The affected portions of the fruit were identified. Through this process the type of defect present in the fruit were also identified. Based on the results, it can be concluded that DNN classification is a key step to produce reliable outcome in detecting the presence of diseases in mango fruit. In future we plan to develop a generic system for fruits. The results obtained can be used for statistical analysis which further decreases the detection time. The cultivation of fruit will also be detected with this system.

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