# APPLICATION OF IMAGE PROCESSING BASED SYSTEMS IN FOOD QUALITY ASSESSMENTS AND SEGREGATION

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## ABSTRACT

This study aims at discussing various techniques of image processing incorporated for finding the food quality. Automatic grading and sorting of food materials like fruits and vegetables grains is gaining importance with the advent of machine vision technology. This study primarily focusses on tomatoes and potatoes seeing that these are the most used raw materials in most food industries. The image processing steps for machine vision applications for determining the quality of food products include image acquisition, image pre-processing, image segmentation, image feature extraction and defect classification. Even though images can be taken in all the bands of the electromagnetic spectrum, only a few are used for defect classification using the captured images. Thus this paper analyses the good and bad tomatoes and potatoes with a very high accuracy successfully using image processing.

## INTRODUCTION

Tomatoes, commonly consumed in daily diets, are a major source of antioxidants. Tomatoes find numerous uses in both fresh and processed forms. Processed forms include ketchup, sauces, paste and juice. Export of these processed products of tomatoes yield more income for country. In order to get good quality of processed products the quality of tomatoes should be good.

Potato plant is a staple in the food diet of many people around the world and ranks second after rice in terms of widespread global distribution. Approximately 34% of the total potato crop is produced in Asian countries. Potato is used in great amounts either in unprocessed or processed form (chips, French fries, and potato flakes). Probably due to its high calorie content, potato has, throughout the years, been a main supplier of energy in people's food.

According to experts, manual quality control methods for both tomatoes and potatoes have the following disadvantages:

• Low accuracy due to such factors as poor lighting, personnel fatigue, etc.

• High Labour Cost

• Lack of consistency due to earlier factors

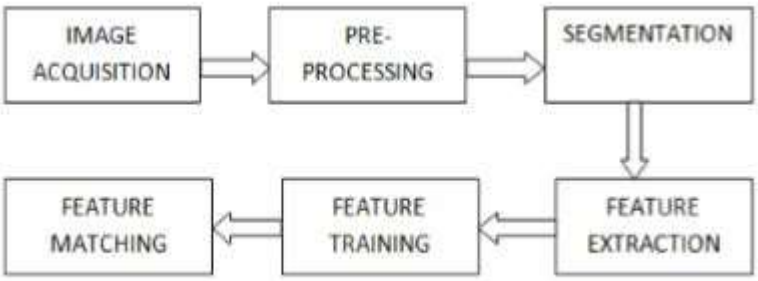
• Lack of integrity as a result of earlier problems.

Therefore it is very important to identify the quality for the purpose of its usage by an automatic sorting machine for various necessities in industries.

## DISCUSSION

### 1. STAGES OF IMAGE PROCESSING FOR SEGREGATION OF TOMATOES

The stages in the proposed image processing methodology are shown below:




## I.IMAGE ACQUISITION

The image acquisition is done using a digital camera and it is loaded and saved using MIL software. MIL works with images captured from any type of colour or monochrome source. MIL supports the saving and loading of images. It supports file formats such as TIF (TIFF), JPG (JPEG), BMP (bitmap), as well as raw format. Here the input image got is an RGB image.

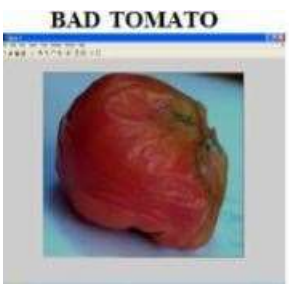
## II.PRE-PROCESSING

Usually the images that are obtained during image acquisition may not be suitable straight for identification and classification purposes because of certain factors, such as noise, climatic conditions, and poor resolution of an images and unwanted background etc. We wish to adopt the established techniques and study their performance. The steps involved in pre-processing are

A. Input Image**:** Here the input image is represented in RGB Format with three matrices of sizes matching the image format. The three matrices in each image corresponds to one of the colours red, green and blue. (Shown below)



B. Background Subtraction: Background subtraction is a process of extracting foreground objects in a particular scene. A foreground object can be described as an object of attention which helps in reducing the amount of data to be processed. Here the figure below shows the image after background subtraction of good and bad tomatoes.



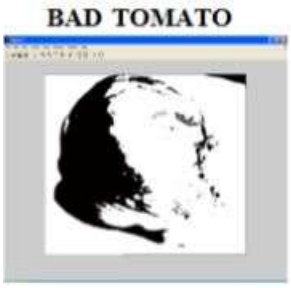

C. Converting RGB to grey: Greyscale images have the only colour which is a shade of only grey in between. To convert any colour to a greyscale representation of its luminance, we must obtain the values of its red, green, and blue (RGB) primaries in linear intensity encoding, by gamma expansion. Here figure below shows the grey images of good and bad tomatoes.



D. Converting grey into binary: The grey image of tomatoes is converted to binary image this means that each pixel is stored as a single bit (0 or 1). Binary images often arise in digital image processing as masks or as the result of certain operations such as segmentation, thresholding, and dithering. Here figure below shows the binary images of good and bad tomatoes.



E. Filtering: The purpose of filtering is to reduce noise and improve the visual quality of the image. Here filtering is carried out by median filter since it is very useful in preserving edges. Median filter is particularly good at removing isolated random noise. Filtered images are shown below.





## III. SEGMENTATION

The purpose of image segmentation is to partition an image into meaningful regions with respect to a particular application. The segmentation is based on measurements taken from the image and might be grey level, colour, texture, depth or motion. Here edge-based segmentation is most suited. As edge detection is a fundamental step in image processing, it is necessary to point out the true edges to get the best results from the matching process. That is why it is important to choose edge detectors that fit best to the application. For this use case, canny edge detector is used.

### IV. FEATURE EXTRACTION

Feature extraction is defined as grouping the input data into a set of features. The features extracted carefully will extract the relevant information from the input data in order to perform the feature matching using this reduced representation instead of the full size input. Here clustering process has been used to extract features form good and bad tomatoes.

Clustering is the processes of grouping together similar objects the resulting groups are called clusters. Clustering algorithms group data points according to various criteria. Unlike most classification methods, clustering handles data that has no labels, or ignores the labels while clustering.

### V. FEATURE TRAINING

Feature training method includes collection of large number of trained features of clustered values of good and bad tomatoes. More number of collecting trained features gives more accuracy. In this method, the number of closest code vectors for each training vector is identified and is stored as the corresponding cluster density. The cluster densities for all training vectors are computed and are sorted in descending order. From the sorted list, the top M training vectors with higher cluster densities are identified and grouped as codebook.

### VI. FEATURE MATCHING

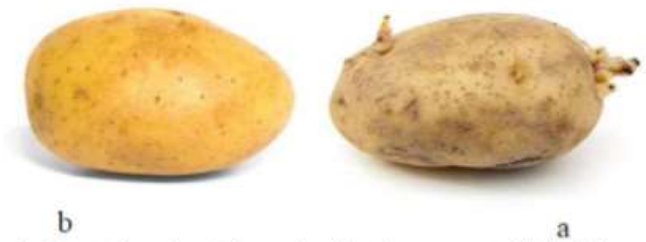
Feature matching methods essentially consist of detecting features in images that can be matched with corresponding features in the other images from which a transformation model can be estimated. Feature matching is an important task in the area of image processing. Here correlation method is used for feature matching. Here the clustered values of good and bad tomatoes are taken more in number. With the extracted features each value are correlated with one another and we get a specific value for good and bad tomato. With these values we can identify good and bad tomatoes.

## 2. STAGES OF IMAGE PROCESSING FOR SEGREGATION OF POTATOES

These are the stages of the process of separation of sprouted potatoes from healthy potatoes in the sorting line.

### I. IMAGE ACQUISTION

The acquisition procedure is similar to that of tomato. Figures of healthy and unhealthy samples are shown below.



b a

Figure 1- Potato Samples: (a) sample with tuber sprouts, (b) healthy sample

## II. IMAGE PROCESSING

The algorithm procedure used in the program is as follows: First, to reduce image volume and increase image processing speed, the image was converted into grey surfaces. Then, the Prewitt filter was applied. The Prewitt algorithm applies onto the image a vertical and a horizontal mask with known coefficients.

| | | |
|---|---|---|
| p1 p2 p3<br>p4 p5 p6<br>p7 p8 p9 | 1 1 1<br>0 0 0<br>-1 -1 -1 | -1 0 1<br>-1 0 1<br>-1 0 1 |
| A 3x3 Sample Window | Horizontal Filter | Vertical Filter |

The formula used for calculating pixel p5 is:
Pixel = (p1+p2+p3-p7-p8-p9) + (p3+p6+p9-p1-p4-p7)

Using the Imdilate function, we expanded the edges found in the previous stage based on a diamond-shaped structure to a radius of 2. Subsequently, the *Imfill* function was used to change to white the color of the holes (black spots) found in the image. Then, two linear structures (one horizontal at 0 angles and the other vertical with an angle of 90 degrees) as well as the *Imopen* command were used to eliminate the extra objects in the image. Ultimately, a number of holes remained, which revealed the locations of the sprouts. Thus, it was possible to check if any sprouts could be found on individual potatoes. This algorithm was applied in the following case studies: two potato samples (Figure 1), one potato with several sprouts (Figure2), and one healthy potato (Figure 3).

The finding and highlighting of the sprouts are exhibited in Figure 2 where the number of the areas can be adjusted via the *bwboundaries* command. As can be seen in Figure 3, no such as are observed, thus, the proposed system would declare the scanned potato as “sound”.

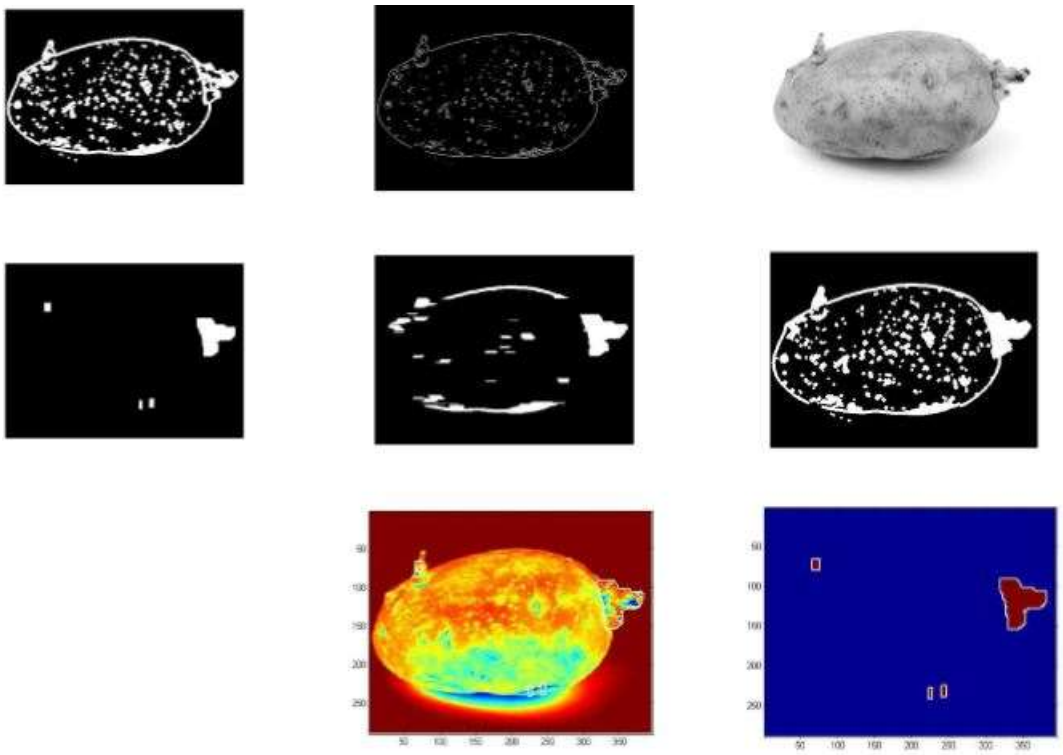


Figure 2- Running the program for a sprouted potato and detecting several sprouted areas

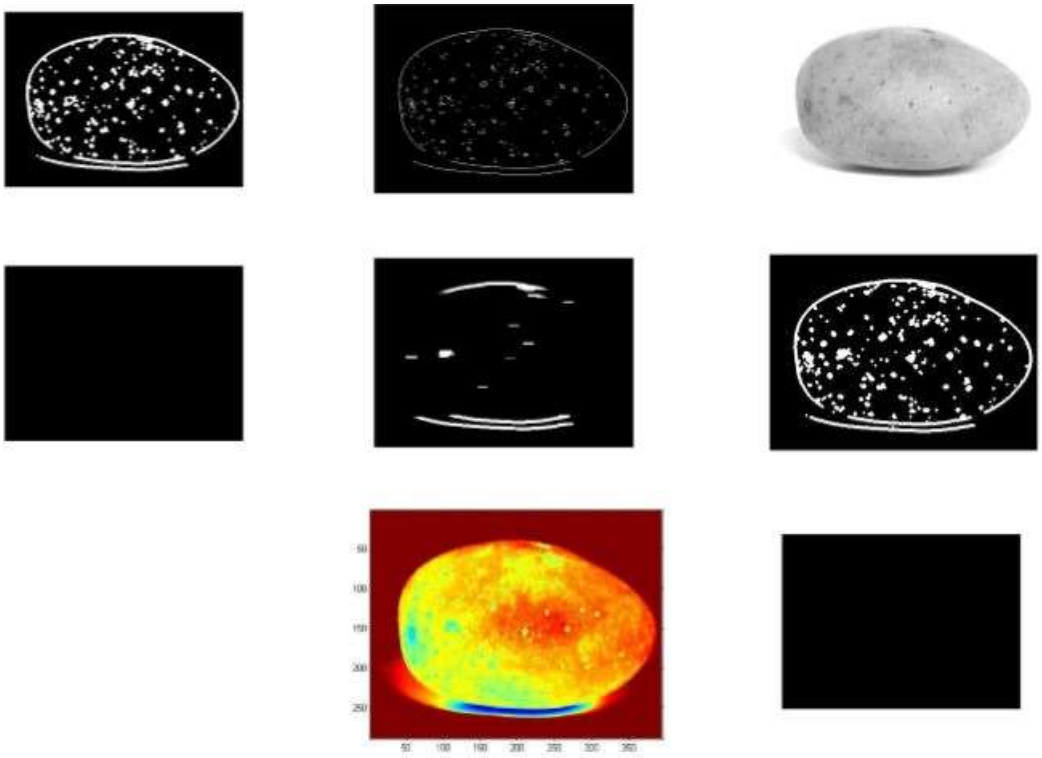


Figure 3- Running the program for a healthy potato: No sprouts are observed

## CONCLUSION

The obtained results showed image processing was an efficient technique for determining qualitative characteristics of agricultural products like potato and tomato. In this study, the identification of good and bad tomatoes based on quality in image processing using MATLAB is successfully done with 80% accuracy. The use of image processing for identifying the quality can be applied not only to tomatoes but also to other fruits such as oranges, apples, melons etc., and also vegetables with more accuracy.

Development of software and hardware technology has made available low-cost solutions which have spread the use of image processing systems for quality inspection of food materials. By introducing small changes, this method can be applied for other products as well. The proposed program, meant for separating sprouted potatoes from healthy potatoes with high accuracy, can be a useful step in increased safety for customers. Placing a mechanical arm at some point along the production line can lead to complete sort-out of the undesirable products.

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