

Design and Development of Potato Sorting Machine Using Image Processing and Machine Vision

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Abstract

Hassan is a largest potato producing district in Karnataka and also leading supplier of quality potatoes during September and December months. Grading of potato is an important factor in marketing process. This paper concentrates on designing of the potato sorting machine using Image processing technology and machine vision. The designing consist the feeder, web camera and a computer and accelerators, based on the size of potato a conveyer belt is used. The captured image were processed using MATLAB software. For primary evolution of the system the potatoes were sorted out in to big, medium and small categories.

Keywords

Camera; MATLAB; Image Processing; Potatoes; Grading.

I. Introduction

Potato (*Solanum tuberosum* L) popularly known as ‘The king of vegetables’, has emerged as fourth most important food crop in India after rice, wheat and maize [1]. Hassan district of Karnataka is an important area in the production of potatoes. Grading of the Potato is an important factor in the marketing process. Grading helps to potato producer and seller to determine the price and reduces the cost of marketing and helps to get standard potato at fair price. Grading may include for different sizes or different types of potatoes. In the marketing process the main problem is grading faced by formers from the buyers. So the aim of this paper is designing a machine which sort or grade potato easily using image processing technique and machine vision for the different sizes easily and efficiently and more over cost effectively. In this proposal it reduces the man work and increases efficiency and consumes less time compared to grading by human.

1. Existing System

Grading of the potatoes is done by hand as well as by graders. The different practices of grading of potato are as follows.

- Grading of potatoes with a set of rectangular sieves having round holes of varying diameters, where a pair of sieves placed above the one another are shaken from and to by two persons and third person continuously feeds the upper sieve[2].
- Grading of potatoes through sieves hung on ropes and move fore and back
- Grading of Potatoes by mechanical grader, where the sieves are mounted on the oscillation of frame as operated mechanically by power. This grader can be operated with 1.0 H.P electric motor, engine or tractor.
- Grading of potato with power operated potato grader with conveyer attachment. The power attachment is 1.5 H.P . It can grade based on different sizes.

2. Proposed System

The proposed system consist the integration of the image processing and machine vision technology. The potatoes are sorted based on their size using image processing techniques such as segmentation, colour image processing and edge detection. So it results into efficient grading of the potatoes with less human efforts. The following steps will briefly explain the sorting procedure.

A. Conveyer

A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. Here we are used conveyer to carry the potatoes.

B. Image Processing

I. Image acquisition

The Web camera is used to take the images of the potato by using image acquisition tool in the MATLAB. The image can be taken either in RGB or Grayscale or YCbCR. We are taking the images in RGB format with 320*240 resolution.

II. Conversion of RGB to YCbCR

The captured RGB image is converted into YCbCr colour space for the purpose of colour thresh holding. The YCbCr colour space is widely used for digital video. In this format, luminance information is stored as a single component (Y), and chrominance information is stored as two colour-difference components (Cb and Cr). Cb represents the difference between the blue component and a reference value. Cr represents the difference between the red component and a reference value. (YUV, another colour space widely used for digital video, is very similar to YcbCr but not identical.) The function `rgb2ycbcr` converts color maps or RGB images to the YcbCr color space. `Ycbcr2rgb` performs the reverse operation.



Fig. 1: Raw image of Potato Fig. 2: YCbCr image of Potato

III. Image Segmentation using Colour Thresholder

Image segmentation is the process of partitioning an image into parts or regions. This division into parts is often based on the characteristics of the pixels in the image [4]. For example, one way to find regions in an image is to look for abrupt discontinuities in pixel values, which typically indicate edges. These edges

can define regions. Another method is to divide the image into regions based on colour values. The various colour spaces exist because they present colour information in ways that make certain calculations more convenient or because they provide a way to identify colours that is more intuitive. For example, the RGB colour space defines a colour as the percentages of red, green, and blue hues mixed together. Other colour models describe colours by their hue (green), saturation (dark green), and luminance, or intensity. The toolbox supports these colour spaces by providing a means for converting colour data from one colour space to another through a mathematical transformation. We are defining following minimum and maximum value for the potato based on webcam. All objects other than potatoes are determined as unwanted objects.

Thresholds for channel 1 based on histogram settings
 channel1Min = 33.000;
 channel1Max = 120.000;

Thresholds for channel 2 based on histogram settings
 channel2Min = 103.000;
 channel2Max = 118.000;

Thresholds for channel 3 based on histogram settings
 channel3Min = 141.000;
 channel3Max = 151.000;

IV. Create Mask

After segmenting the foreground and background, you can swap the foreground and background by clicking Invert Mask. Inverting the mask can be helpful when, for example, you can achieve a cleaner segmentation working with the background but you want a mask of the foreground. Perform the segmentation with the background, and then invert the mask. By using following function.

Create mask based on chosen histogram thresholds

```
BW = (I(:,:,1) >= channel1Min ) & (I(:,:,1) <= channel1Max)
&...
(I(:,:,2) >= channel2Min ) & (I(:,:,2) <= channel2Max) &...
(I(:,:,3) >= channel3Min ) & (I(:,:,3) <= channel3Max);
```

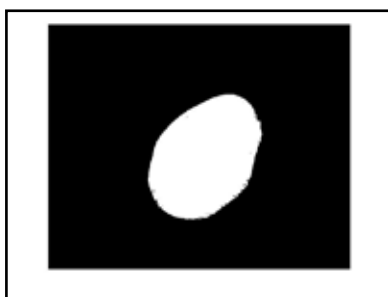


Fig. 3: Binary image of the Potato with mask

V. Calculation of Area

The calculation of the area of binary images by using bwarea function [4]. It estimates the area of the objects in binary image BW. Total is a scalar whose value corresponds roughly to the total number of on pixels in the image, but might not be exactly the same because different patterns of pixels are weighted differently. BW can be numeric or logical. For numeric input, any nonzero pixels are considered to be on. The return value total is

of class double.

3. Flow of The Project

After passing the potatoes on conveyor on some point a webcam will take the live image of the potato in RGB colour space it will send the image to MATLAB for further process. After the image received by MATLAB it will convert the RGB image into YCbCr image it helps in case of colour image processing.

After conversion of RGB image into YCbCr, the image is undergoes to colour thresholding by the help of predefined minimum and maximum value of the blue and red component of the captured image and performs a masking operation to eliminate the background which is nothing but a colour is not related to the colour of the potato.

Finally we are going to calculate the area of the binary image of the object and compare with the predefined area values. According to the predefined area we are going to differentiate the different sizes of potato and sending the signals to respective actuators [5].

4. Results

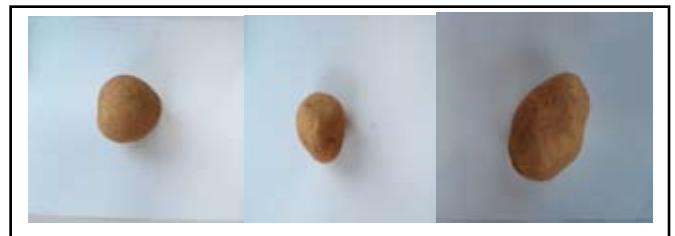


Fig. 4: Big potato Fig. 5: Small potato Fig. 6: Medium potato

Outcome of the Algorithm:

- Area of big size Potato = 3.3638e+004
- Area of medium size Potato = 1.4565e+004
- Area of small size Potato = 1.2690e+004

5. Conclusion

The project has designed potato sorting machine using image processing and machine vision. All drawbacks of the conventional grading methods can be eliminated by this technology. The conclusion is that, the prototype designed can sort the potatoes efficiently and also quality of the object is also analysed. Other objects are detected as unwanted and not sorted.

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