International Journal of Advanced Information Science and Technology (IJAIST) ISSN: 2319:2682
Vol.5, No.1, January 2016 DOI:10.15693/ijaist/2016.v5i1.89-92

Design and Implementation of Image processing Techniques for Automatic Bottle Filling and Label Checking using Raspberry pi: A Survey

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***Abstract*—This paper aims to present a review of various techniques used for automatic bottle filling and label checking. In this work for detection of correct liquid level in bottle image processing techniques are used. This will check whether the bottle is filled with proper quantity of beverage or not. If the bottle is not filled up to reference level it will refill the bottle. Label checking of bottle is done to check whether the proper label is present or not. In this system various image processing techniques are used for liquid level detection such as image filtering, image Thresholding, image segmentation, edge detection techniques, contour fitting. The advantages and disadvantages of the techniques are mentioned in this paper. The major goal of the paper is to provide a comprehensive reference source for the researchers involved in automatic bottle filling and label checking. This whole system is controlled by the raspberry pi unit without disturbing the fast production line.**

Index terms -Automatic bottle filling, Label checking, image thresholding, Edge detection, Image segmentation, Morphological functions.

I. INTRODUCTION

Indian food industry is perched for huge growth. There are many soft drink companies in market so it is very important to take care of quality and quantity of product. To maintain the quality of large number of bottles is not easy job with manual inspection [1]. For these reasons image processing techniques are used in bottle filling system. In this system bottle is continuously moving on the conveyor belt. In the vision based automated system the camera is used to capture the image. Camera resolution, conveyor belt speed and background color is important factor [1]. In the captured image noise is present so noise filtering is done on that image to remove noise [2]. After image filtering, image segmentation technique is used to separate the liquid region from the background. Contour fitting is applied on the segmented image to detect correct liquid level in the bottle [3]. The level of liquid in bottle is compared with the reference level for detection of proper level. The problem in bottle filling system is improper or missing label on the bottle. For the detection of correct label image processing is used. Thiswhole system is control by the Raspberry pi unit. Which is low cost on board minicomputer.

II. BOTTLE FILLING METHODOLOGY

Bottles are moving on the conveyor bottle. The camera capture the image continuously. On the captured image processing techniques are used to detect correct liquid level in the bottle.

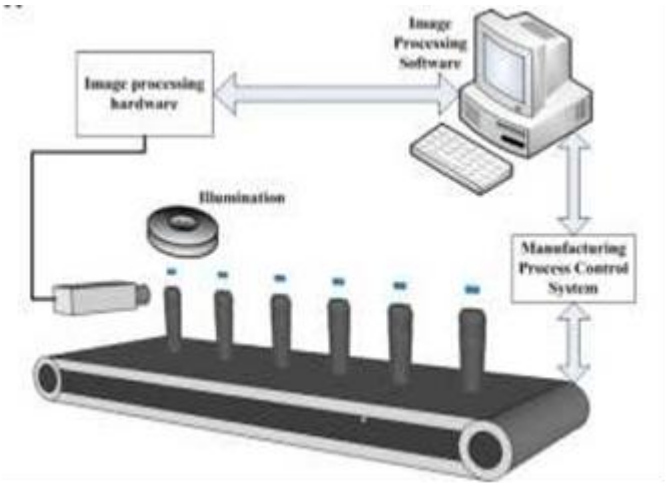

Fig.1.GeneralBlockdiagramfora typicalbottlingAVIS[4].

A. Image filtering

In this step, on captured image noise is present in the image. Various noise filtering methods such as median filtering, mean filtering, Gaussian filtering, Min-Max filtering are used to remove the noise. Among all filtering methods median filtering provide better results [2].

B. Image segmentation

In this step, various image segmentation techniques are used to find the region of liquid in bottle. The segmentation methods are used for liquid level detection are edge detection based and Thresholding based.

C. Edge detection techniques

The Edge detection is one of the most commonly used operation in image analysis. An edge is defined by discontinuity in gray level values and the boundary between and object and background [5].

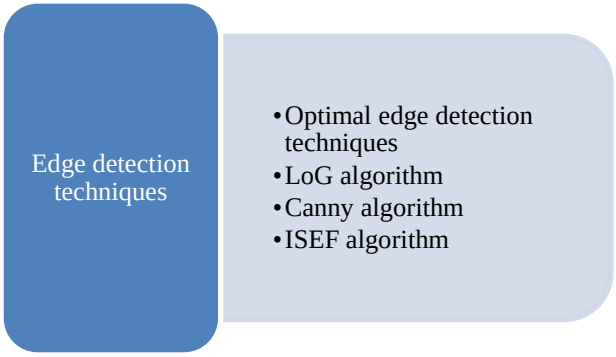

Fig. 2. Reviewed methods for edges detection [5].

1. Optimal edge detection algorithm

Sobel edge detector is template based edge detector. The disadvantage of this edge detector is its dependence on thesize of objects. This edge detector is highly sensitive tonoise and inaccurate too [5].

2. LoG algorithm

The locality of LoG operator is not good and edges are notalways thin. It is better than the sobel operator in case of low signal to noise ratio. In the Log operator gray level intensityfunctions varies, not finding the orientation of edge becauseof Laplacian filter [5].

3. Canny algorithm

Canny specified three issues: Error rate, LocalizationResponse. In the canny edge detection no edges are missedit cover all edges in the image. The actual edge found by thecanny operator is small as possible. Canny edge detector convolve image with derivative of Gaussian. Thedisadvantage of the canny algorithm is sometimes noiseappear at edges [5].

4. ISEF algorithm

Shen- castan infinite symmetric exponential filter is optimaledge detector. Shen-castan algorithm uses hysteresisThresholding. Due to the hysteresis Thresholding streakingproblems are avoided. In the ISEF algorithm after edgedetection morphological closing is used for thick edge [5].

D. Image Thresholding techniques

Image Thresholding is the technique of image segmentation. In the Thresholding technique colour image or gray scale image is converted into the binary image. Image Thresholding separate the object from the background.

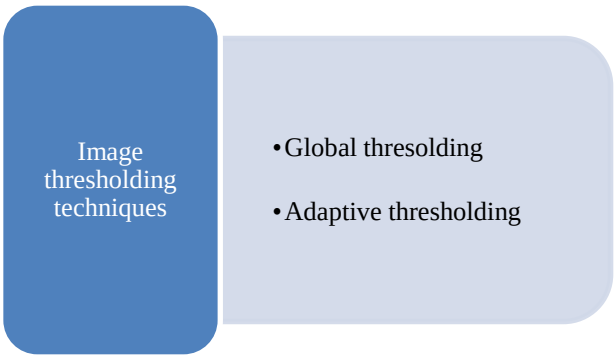

Fig. 3. Reviewed methods for image thresholding [6].

1. Global Thresholding

In global thresholding technique single threshold value isused for whole image.

$$g(x,y) = \begin{cases} 1 & i(x,y) \geq t \\ 0 & i(x,y) \leq t \end{cases}$$

Where g(x,y) =output image

i(x,y) = input image

t= threshold value

Global thresholding works better when the histogram ofimage is uniformly distributed. The disadvantage of theglobal thresholding technique is that it give badsegmentation under varying light condition.

2. Adaptive Thresholding

Adaptive thresholding technique image is divided into the sub images. The thresholding value is depend on the neighborhood pixel properties. Separate thresholding value is used for all sub images. This algorithms works fine under the varying light condition and it provide better segmentation compare to the global thresholding technique.

III. LABEL CHECKING ALGORITHM

Optical Character recognition

Sometimes the problem in bottling industry is missing labels on the bottle. For checking the presence of label on the bottle, Optical characterization (OCR) method is used. In the OCR template matching algorithm is used. In the template matching algorithm character or alphabets are recognize by comparing two images of alphabets or characters. The template matching algorithm involves: image acquisition, image filtering, image thresholding, clustering the image of alphabet and lastly recognize the alphabet [1].

IV. HARDWARE DESCRIPTION

Raspberry pi2 model B:

Raspberry Pi2 is on board minicomputer. The Raspberry Pi2 runs Linux based operating systems and there is a specialized version of Linux based kernel known as Raspian which can run almost all programs which are Linux compatible. Hence in this project we have used python. As shown in figure- 4

Raspberry pi2 model has 1 GB RAM. It has 900MHz quad-core ARM Cortex-A7 CPU. Raspberry Pi2 model has four USB ports.

Fig. 4. Raspberry pi2 model B [7].

These USB ports are used for interfacing of camera, keyboard and Wi-Fi dongle. It provide one LAN port for communication. It has 40 GPIO pins for input and outputs. It has one HDMI port. It can play 1080p resolution videos without lagging. It has a low price relatively as compared to machines in the market [7][8].

VI. Conclusion

This paper provides the overview of the various techniques used for automatic bottle filling and label checking. Web camera used for the capturing the image. On the captured image noise filtering techniques are used. Among various filtering methods median filtering is works best. After the noise filtering image segmentation techniques are used. As compared to the global Thresholding technique adaptive Thresholding technique gives better segmentation under varying light condition. In Edge based segmentation various edge detection algorithms are used suchas LoG algorithm, Sobel operator, and canny algorithm and ISEF algorithm. Among all algorithms ISEF algorithms works best. As compared to the edge based segmentation, thresholding based segmentation required less time for computation. After applying edge based segmentation techniques or Thresholding based segmentation techniques we apply the data to Raspberry pi to control whole process.

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