E-BOTTLE FILLING

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Abstract: India ranks 5th in the food production and consumption. Soft drinks industry is the one of the most food production industries [1]. But the industries still face many problems in liquid levels. The main aim of this project describes the design of automatic inspection of bottle filling and packing. The inspection of bottle filling is done by capturing the images of the bottles filled by using the image processing without disturbing the production line. The process goes in two stages. They are Inspectionand Segregation. Firstly after the bottles are filled they are inspected for the liquid level and then segregated based on the results of the inspection for refilling. As the bottles are moving on the conveyer belt they are first filled without disturbing the production line. This system could be more accurate and will replace the present conventional system of monitoring by humans and there by increases the productivity and profitability.

Keywords - Image Processing, Segregation,Profitability,Point to Point Evaluation

I. INTRODUCTION

In the present day established market soft drinks ranks first among the manufactured beverages even more than coffee and milk in terms of per capita consumption. Global consumption of soft drinks is increasing day to day. So these soft drinks are madeavailable in every conceivable size and flavor to satisfy people taste. As the consumers are becoming more mobile it is comfortable to carry packed goods. Soft drink packing has become lighter and more portable with aluminium can and resalable plastic bottles. In the early 1960s there are only 150 bottles manufactured per minute. As the product demand increased they shifted to fast machinery. Filling lines run in excess of 1,200 bottles per minute. And this highly automated machinery reduces the employees required to operate the lines. As more and more products are evolving day by day the accuracy is decreased. These days we see many errors like, over filling or under filling, improper label, cap enclosure etc., which is loss to both the customers as well as the manufacturer. So this project aims in inspection of correct level of bottle filling.

Though we had used many techniques for bottle filling we still see many defects in the level of the bottle filled. Some of the filling techniques like [1]

1. Flow Meter
2. Time Specific
3. Weight Based
4. Level Sensing

Here flow meter is based on density of liquid. Time specific is fixed amount is time is set to each bottle and liquid is filled accordingly. Weight based system is fixedamount of weight is set to each bottle and when the bottle is filled to that weight then it is moved. And finally level sensing system is a mark is drawn on the bottle and when the bottle is that level sensor senses and stops filling. Even after using all these techniques we find many defects in the present day system which is very loss to the industry. This might be due to the ageing of the machinery. So this project concentrates on the inspection the bottle which is filled rather than inspecting it while filling.

II. PROBLEM STATEMENT

Now a days we see many defects in bottles i.e., they might be under filled or over filled , the cap might not be set properly, the label might be properly printed or placed properly .This impacts on company's profit and consumers belief on the quality of the product. In order to avoid that, a system must be implemented which is reliable and cost effective. Previously in some of the industries this work is done manually, but this is not effective and accurate. The checkpoint is an acrylic background illuminated with a high intensity of light, this causes work diseases like cataract [1].And manual inspection is not advisable as some times it could not detect fewer bottle .For these reasons, we performed inspection of the bottles and then segregating it to refill it properly to increase the profitability.

III. RELATED WORK

Here in this project we are using Image processing to inspect the captured image. When the image is captured the liquid level has to be detected from the image captured. There are many methods likeImage thresholding, contour fitting, Edge detection, Image cropping, etc.In [3] author used thresholding and contour fitting to extract the liquid level. In [4] author used thresholding techniques to detect the liquid level from the captured image. Among all thresholding technique provides faster output.

There are two thresholding techniques:

1. Global Thresholding
2. Adaptive Thresholding

Global thresholding: Choose threshold T that separates object from background. In this only one thresholding value is present .The below figure shows the Image histogram of global thresholding.

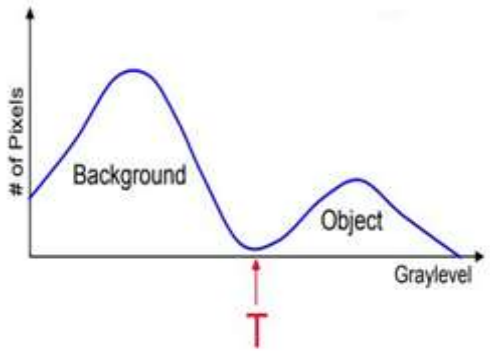

Fig1 Image Histogram for Global Thresholding

Adaptive Thresholding: Every pixel in image is threshold according to the histogram of the pixel neighbourhood. It is divided into sub images.

Compared to both the thresholding techniques adaptive thresholding provides better results. Adaptive thresholding provides better results in light varying conditions than the global thresholding .consider an example to know better aboutglobal thresholding and adaptive thresholding.

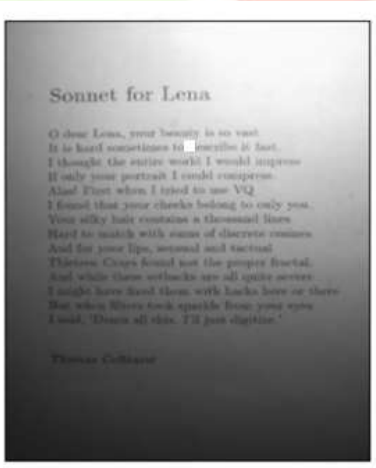

Fig2: Original Image (captured by the camera)

(a) (b)

Fig3: (a) Global Thresholding Fig: (b) Adaptive thresholding

So by seeing the above example we can conclude that adaptive thresholding provides better results even under light varying conditions.

IV. PROPOSED SOLUTION

From the above block diagram, all the components are connected to the Raspberry pi board. Firstly let us allow the bottles to move normally and filled without disturbing the system. Now after the bottles are filled they move towards the IR module. When the IR module senses the presence of the bottle, IR module sends the input to the controller .Then the controller instructs the camera to capture the image. When the Image is captured it has to follow few steps [5]

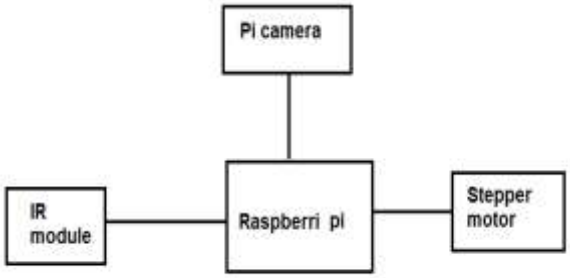

Fig4: Block Diagram of the system

The major hardware components required to setup this system are:

1. Raspberry pi board
2. Pi camera
3. IR module
4. Stepper motors

Here the IR module is required to detect the bottles moving on the conveyer belt and are approaching towards the Pi camera When the IR module senses the presence of the bottle it sends the input signals to the controller and pi camera captures the image .the above techniques are applied on the captured image and exact liquid level is obtained .based on the level it decides whether to send the bottle towards packing or refilling .using the stepper motor the bottles are segregated. The below flow chart describes the exact procedure followed.

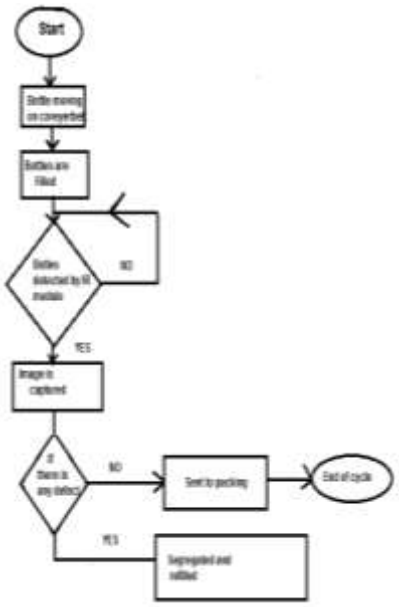

Fig5: Flow Chart of the system

a) Image Filtering: When the Image by vision system it is unable to use it directly. They may be corrupted because of random variations (noise) in intensity, poor contrast. Salt, pepper noise, Gaussian noise and impulse noise are some type of noises corrupted while capturing an image .So in order to remove the noise from the captured image, image filtering techniques has to be used .Some of the image filtering techniques are Linear filtering, Gaussian smoothing, Median filtering. Among all image filtering techniques median filtering is the best [7]

b) Image segmentation: Divide image into (continuous) regions or sets of pixels

1. Region Based
2. Boundary Based
3. Edge Based

After the Image is extracted from the background the correct liquid has to be identified. The liquid can be extracted by 3 methods namely, Point-by-point evaluation of the curve surroundings, Direct point-by-point evaluation, Regions difference. Now let us consider direct point-by-point evaluation. In this method we evaluate the surface of the liquid by evaluating the values of the pixels. It follows four steps [6]

1. Find the corresponding pixel in the image.
2. For every pixel value assign the value as I and the normal angle as θ and the gradient image direction as ϕ at that pixel value.
3. Now calculate local score value as I or I.cos (θ-ϕ).
4. Calculate the curve score value as the average of all the local score values.

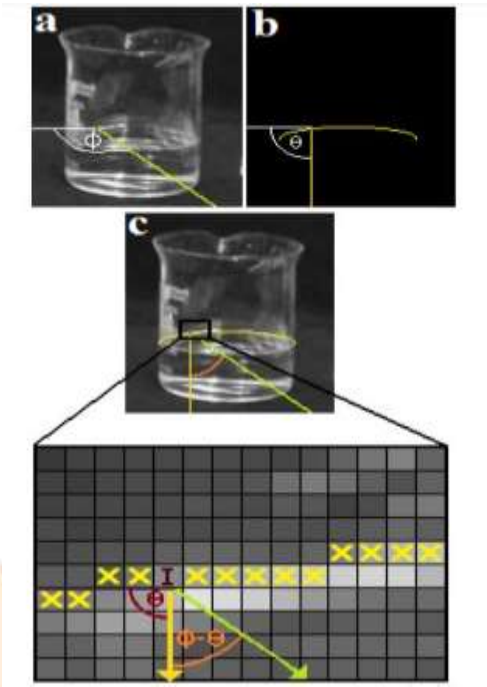

Fig6: Point to Point evaluation

V. SOLUTION

The software used to control the system is python. When the components are connected as shown in the block diagram the following simulation results are obtained. The simulation results for level detection and segregation are shown below

When the liquid is to the desired level the simulation result is

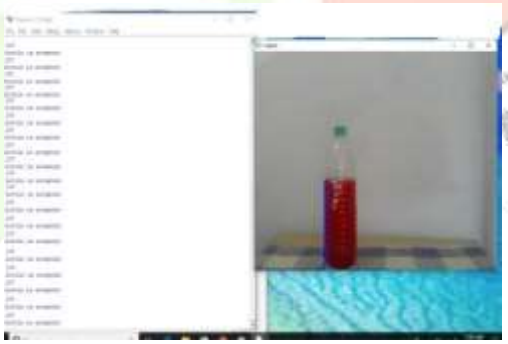

Fig7: Simulation results when liquid is to the correct level

And when the liquid is either above or below the desired level the results are

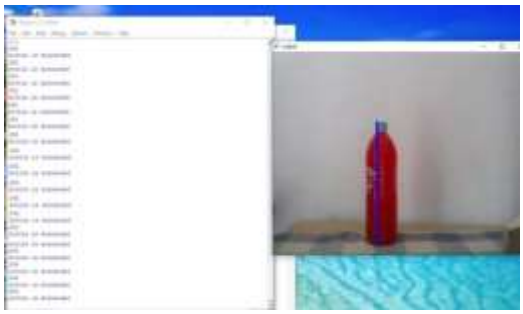

Fig8: Simulation results when filled to undesired level i.e.., the bottles are discarded

VI. REFERENCES

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