



WATER COOLER BOTTLE INSPECTION



using Roto Photo material handling and positioning system

AN EXERCISE IN MATERIAL HANDLING

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24 June 2010

Water cooler bottle inspection

Overview

Recyclable beverage containers are an economical and practical way to deliver basic beverage products to consumers. However they all suffer one significant issue. The possibility of foreign matter being introduced either inadvertently or deliberately.

Of course modern processing plants feature quite extensive wash and rinse functions. But the efficiency of these systems is a function of the type of contaminant or foreign material along with the effectiveness of the wash system to remove the contamination. The risk to large beverage manufacturers with considerable brand value is therefore significant.

The best designed and maintained systems can never guarantee the cleanliness of the container, so some form of inspection is usually required. Automated inspection systems are now available for a wide range of duties, however, the water cooler bottle has always presented major problems for inspections systems due to its size and the difficulty associated with material handling.

Industrial Photonics has overcome this problem by developing a unique motion control system which presents each bottle to an array of high resolution cameras located at the optimal inspection angle.

The first system has been deployed at Neverfail Spring, Brisbane Australia. Neverfail is a division of Coca Cola Amatil Ltd. the Australian bottler of Coca Cola brand products. Neverfail production staff worked with Industrial Photonics engineers to develop a specification which would provide adequate assurance that the following defects could be reliably removed:

- Foreign objects in neck area
- Foreign object in handle area
- Label position and condition
- Label type (foreign supplier)
- Major cracks
- Major scuffing

Current Status

In the current process bottles are moving on the production conveyor immediately after the wash machine station:

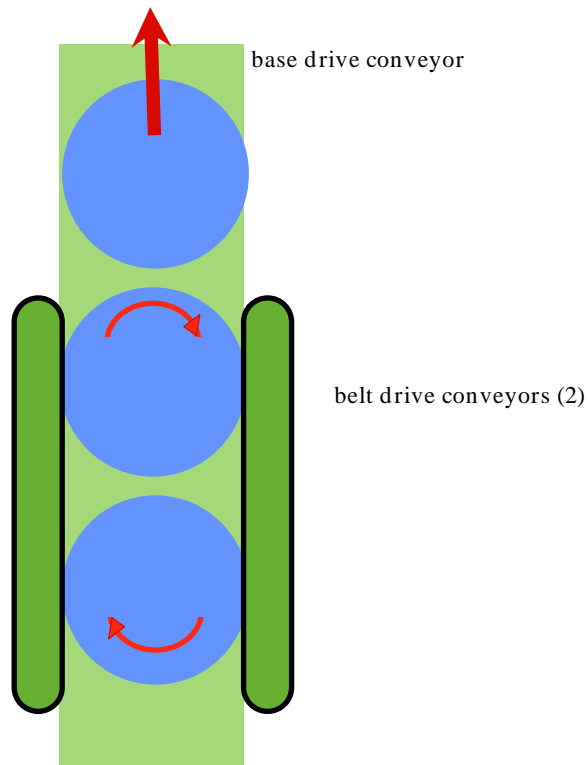
- process speed is 1 bottle per second max.
- conveyor speed is approx. 18 meters per minute
- Bottles are standard 15 liter polycarbonate
- Bottles are still wet from the wash function

Solution

In order to meet the required specification it was quickly realized that images from several controlled angles would be required to provide the client with the required product security. The ability to stabilize and control the motion of large water cooler bottles was therefore considered to be crucial.

The Industrial Photonics Roto Photo system is designed to fit into an existing conveyor system which carries the bottles. The system has three conveyor drive systems:

- A base drive system which is a normal slat conveyor format. The base conveyor is designed to convey the bottle through the system.
- Two belt drive conveyors which drive on the bottom rib flange of each bottle. The two belt drives are designed to induce bottle rotation so that a correct field of view can be attained.



The Industrial Photonics Roto Photo system uses three PPT Vision smart cameras to perform the required vision inspection duties. The cameras are mounted on a purpose designed machine designed to present the bottles in a controlled way to each of the cameras.

The Industrial Photonics Roto Photo allows for:

- Image of the internal base via the neck
- Two side view images as the bottle is rotated past the two side view cameras.

Process

The first camera is a PPT Vision T37 which has a field of view (FOV) through the neck of the bottle. Lighting at this station is achieved by a Smart Vision wash down rated white LED backlight. The following image is typical of what is achieved at this inspection station.



The second step involves taking images from at least two perspectives of the side view of each bottle.

- One perspective would capture the handle area in silhouette with a view also of the bottle side wall.
- A second image needed to be collected with the label in full view. This perspective happens to be at 90 degrees to the handle image and will permit identification of the label. This is crucial to Neverfail because it is essential to remove bottles from other suppliers from the Neverfail process line.

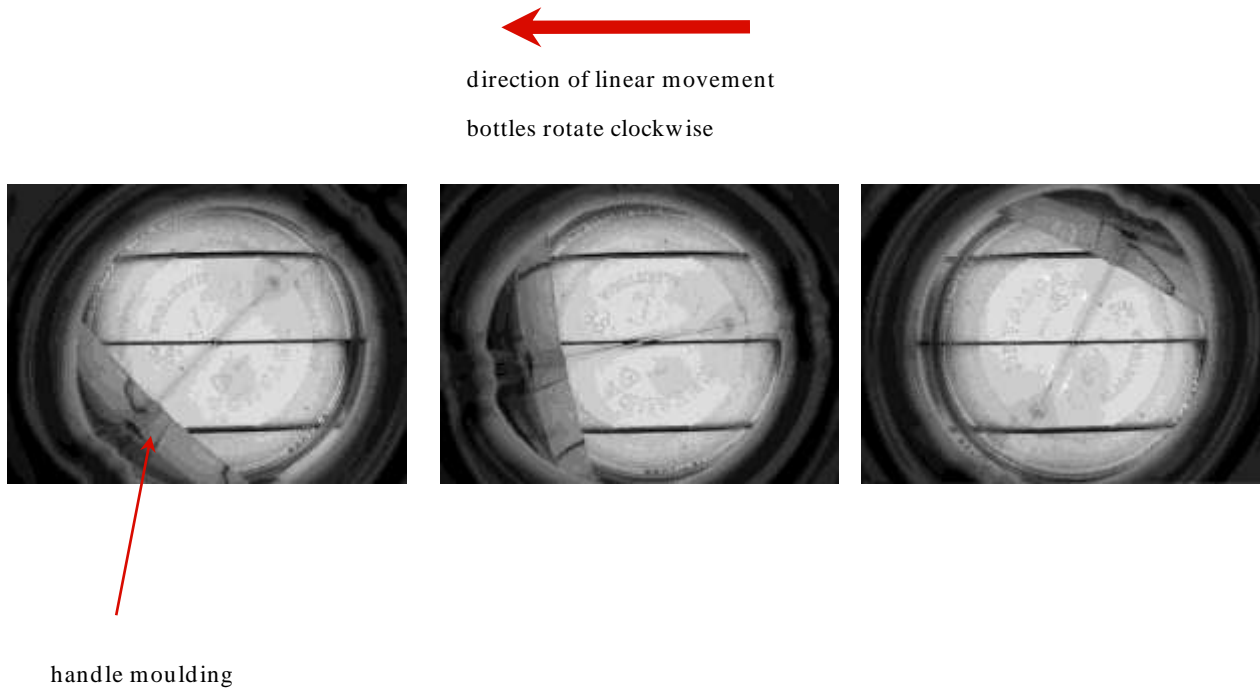


Motion control

The major issue became, how to trigger the cameras for side views with the product in the correct rotational position.

In the final solution, a PPT Vision T37 camera takes an image through the neck of the bottle. The image is triggered by a precision through beam detector. This degree of precision is required because the bottle is moving reasonably quickly at the point of image collection and the neck is quite narrow.

A typical image through the neck is shown in the next series of images.



The following should be noted from the images above:

- It should be noted that the handle may be in any position relative to the conveyor when the top camera is triggered.
- The three black lines are the conveyor support structure. These bars are required to keep the bottle stable on the conveyor. The bottles are 15 liters in capacity and quite light, so stability is a major issue.
- The support bars are removed from the image by using the appropriate tool in PPT Vision VPM software package.

The T37 camera calculates the necessary angle of rotation required for each side view image. Two 9200 series cameras are used to collect the two side view images. Both cameras have the software required to perform both the handle area and label area image inspection routines.

The T37 camera determines which inspection routine needs to be done by the first 9200 camera. This could be either the handle or label inspection depending on bottle rotational position at the time that the T37 image is collected.

A signal is given to the first 9200 camera to perform the required inspection. At the same time, the PLC is advised what angular rotation is required to achieve the best image at the first 9200 camera. The PLC will calculate the number of pulses required to trigger the first 9200 camera.

The T37 also calculates the rotational angle required to collect the second image. The second image will be whatever the first 9200 did NOT collect (handle or label). Once again the PLC counts the required pulse and triggers the second 9200 camera.

≈VPM design

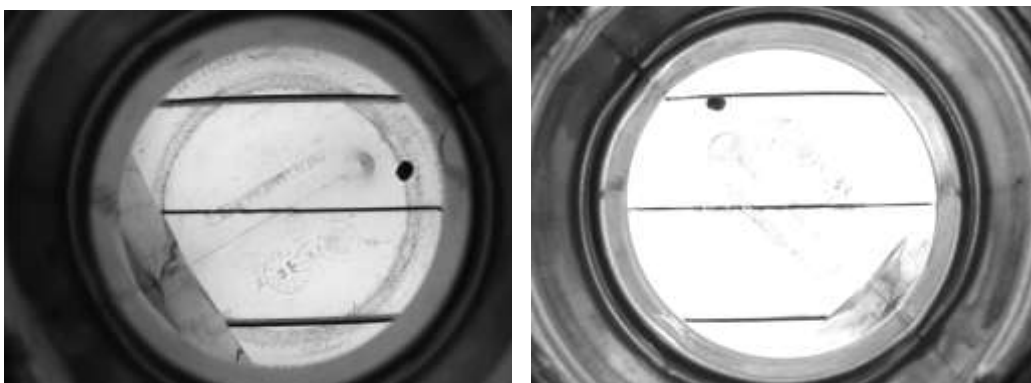
The inspection routines at each camera perform two basic function:

Foreign matter.

These defects typically take the form of introduced objects such as pens, cigarette butts, coins etc. The system essentially locates the base of the bottle and performs a blob analysis looking for dark objects.

This algorithm is made more complex by the fact that bottles are inspected immediately after the wash machine, so the bottle is wet both inside and out. In some cases there is quite a substantial amount of water in the base of some bottles. Testing has shown that the system can accommodate this to a large extent provided bottle motion is smooth and regular as is the case most of the time. If the bottle is severely shaken then the resulting bubbles will cause a defect result.

The images of the base also reveal that the handle moulding obscures part of the base area. The client accepts that this is not possible with the current machine design.



The two side view cameras also do foreign object searches essentially using blob analysis in various assigned search areas. The handle area is of particular interest. During the bottle wash function, most smaller objects will fall out through the neck opening. However larger objects can become caught either in the neck area or in the handle area which is hollow and forms a natural trap for long narrow items such as drinking straws and pens etc.

The handle is there assigned a specific search routine and once again uses blob analysis to locate foreign objects.

Label identification

The system is also required to identify the Neverfail label as being present. This is an important issue because bottles from competitors are routinely returned via the Neverfail pick up service. Naturally Neverfail do not wish to fill and ship these containers. Removal from the line is therefore a significant issue.

The VPM software therefore has substantial label detection and pattern match functions to detect and confirm that the Neverfail label is present. Some analysis of the condition of the label is also possible so bottles with missing or severely damaged labels are also removed.



CPM design

The CPM user interface is quite simple for this application. There is only one product so no product selection menu is required.

The system is provided with some sensitivity adjustment for foreign object size and grey-scale intensity.



Service and support

The Industrial Photonics Roto Photo system is covered by a twelve month warranty on all parts and workmanship. All components used are standard items available in most locations. Each system is typically fitted with a 3G GSM modem which allows Industrial Photonics engineers to access the system and assess performance. The engineering team can also make on line adjustments to the software and upload to the system.

Each system is also delivered with up to date manuals and specifications of the Roto Photo system which are compiled on an Apple iPad. These files and drawings can be updated electronically by Industrial Photonics staff so the latest version is always available to field staff for trouble shooting.

For more information on the Roto Photo range of inspection system, contact Industrial Photonics Pty. Ltd

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Roto Photo systems are available for:

- water cooler bottles
- round soup packs
- square tray packs
- canning lines
- bottle and jar inspections