glass WORLDWIDE

Stop searching for defects in glass containers

According to Amir Novini and Ryan Wilson, the way to evolve glass container inspection is to stop searching for defects, making defects reveal themselves instead.

As the world changes and technology advances, demands on glass container manufacturers are intensifying. From intricate decorations and functionally purposed structural features to lightweighting efforts, the bar is constantly rising. Meanwhile, inspection techniques and technology have remained sluggish in advancement and sometimes static in ability to inspect the latest container designs, shapes and sizes.

Applied Vision has been deeply invested in the world of glass for over 30 years, mostly selling or licensing its technology through an OEM. Industry standard tools were utilised, while still strategising and devising solutions for a time when technology could catch up with the company's previously 'outlandish' designs.

Times are changing however and the company's gaze is now directly focused on the industry, bringing the knowledge and experience of decades in computer vision technology. With that expertise under its belt and the modern computing power now available, Applied Vision's own evolution in glass inspection has become possible and a solution came to mind: 'We have to stop searching for defects.' Which does not mean that none are found!

The algorithms and techniques that have been used to this point have been compromises, avoiding trouble areas of containers, neglecting decoration, handles and abnormally shaped non-round ware, waving the white flag on certain sections of containers. Instead, zones of inspection have had to centre on areas that were friendly to inspection, using tools that examined those pixels, looking for any visual distinction and marking them as bad, sometimes blind to the fact that they were normal occurrences!

Lighting, lensing and logic

The company's approach to inspection seeks to make defects reveal themselves. To end the search for defects, there is no laying down of zone after zone of inspections, while also avoiding compromises in trouble areas. Applied Vision does not look for flaws but instead, figures out what a good bottle looks like and lets the defects expose themselves in the contrast. It wants to do this using minimal contact with the container. To get here it was necessary to re-examine and reinvent the three pillars of the company's process - lighting, lensing and logic.

In order to see the container in a novel and useful way, minds were opened up to using the entire spectrum of light and not being limited to just a single narrow band of the visible, as had been done in the past. The versatility of lighting arrays was expanded to levels previously unimagined. The company's multi-spectral lighting has put a spotlight on features of glass previously difficult to image. Within a few clicks, it is possible to change patterns of light and illuminate containers in a variety of combinations. As a result, defects that were challenging to spot yesterday are able to shine today when the correct composite of light is directed at them. These illumination techniques are utilised across the board, in both Volcano sidewall inspection and Volcano top down inspection.

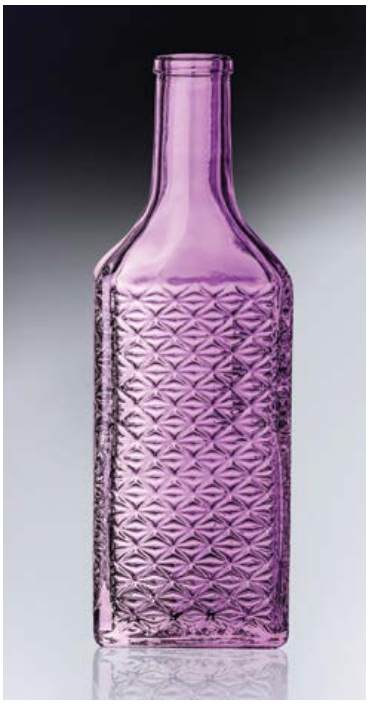
To compound the image advancements, the limitations of lenses themselves have also been tackled. In the company's sealing surface and base inspection modules, lens settings and camera positions have become an exact science. With motorised and calibrated components that hone in on where they were set for each container, repeatable results are ensured for future runs of the same container. In sidewall inspections, the company is mapping and correcting even the most miniscule of distortions in the image attributable to lenses. Images now display a representation of the container bettered only by holding the actual container in a hand.

Leading edge inspection logic

Taking giant leaps in lighting and lensing would be just for show if the company did not move to the leading edge of inspection logic. The next generation of algorithms is a revolution on the old methodology of searching for defects. The improvements made in this arena are too many to describe in detail but given below are some highlights.

Top down inspection of non-round containers has become as easy as their round counterparts. The inspections used to examine a round container can now be the same as non-round when Applied Vision software is used to unravel the sealing surface and convert it to whatever shape is required.

Statistical mappings are used to determine bottle orientation down to a degree of rotation. Knowing the orientation of a bottle provides the ability to accept non-oriented and even non-round ware and still inspect with confidence. Using only a single bottle as an example, systems can learn and report the angle of rotation for all subsequent bottles of the same shape.



Decorative non-round glass container.

Analytical distributions in inspections can learn from a set of containers exactly what a good bottle should look like. And here is the most miraculous part of this dynamic… the set of containers learnt from does not have to be perfect. Glaring defects can be included in the set of containers

Volcano glass inspection system.

trained on, allowing the company to create a 'digital training set' for an ideal container. This analysis is so sophisticated that even the containers learnt from can be run back through inspection and the system will discover defects in them. Furthermore, as more and more containers are run through inspection, the analysis becomes even more precise. The distributions have the ability to continue learning as ware runs, meaning the company can adapt to subtle process changes previously considered benign.

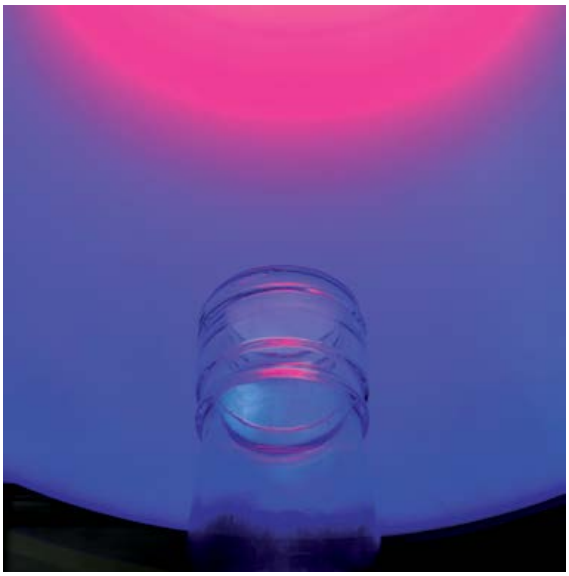
When these advancements are combined with a union of eight views from all angles, Applied Vision is able to build a complex blueprint of what a container should look like from any given angle, at any degree of rotation. Containers that are fed through the sidewall machines are examined holistically, which allows this latest evolution in glass inspection to be realised.

Once it is known what a container should look like, the defects stand out like fireworks! Searching for them becomes unnecessary. Instead, the defects are revealed against the backdrop of an ideal container.

Constant innovation

Applied Vision's job is not through with merely finding defects, however. Innovation continues with the ability to pick out which defects are process-acceptable and those that make ware desirable to reject. The company can fine tune sizes, shapes and even classify types of defects based on numerous criteria. It can reject ware if the severity of a defect is too high but at the same time, has the ability to reject ware if too many minor defects are found. Features can even be ignored if they are considered common and benign occurrences, such as seams.

Alongside these advancements, the company is constantly bettering the ease of use in its systems, starting in the physical realm and carrying all the way through its software. From motorised devices that remember where they are supposed to be and lenses that recall how to focus on a previously run container, to self-learning algorithms that make inspecting new containers a breeze. With each development, the operator's list of worries is being reduced, so they can focus on the goal of every manufacturer… making quality glass products. ●



MultiView inspection system.

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