

WITH THE EDGE TO THE ROUND

CAMERA SENSOR CHECKS VARICOLORED BOTTLE CAPS

Is there a reason to celebrate, not only pop the champagne corks, but also hiss various bottle caps with increasingly popular mixed drinks. In order that the drinks reach in perfect quality the consumer, especially with regard to the transport of the bottles their closures must be 100% controlled during bottling. No easy task, as an application in a wine and sparkling wine cellar shows.

The Peter Herres wine and sparkling wine cellar was founded in 1954 in Leiwen an der Mosel and relocated its headquarters in 1959 to Trier. This forms the core of the Herres Group, which today is a major international supplier of classic and innovative mixed drinks in the segments sparkling wine, frizzante, cocktails, premixes, non-alcoholic wellness drinks, etc. At the company's registered offices in Trier with about 140 employees, there are amongst others five bottling plants, where about 650,000 bottles are bottled daily.

FREQUENT PRODUCT CHANGES MAKE DETECTION DIFFICULT

"At one of these plants, we mainly fill smaller bottles with a capacity of 0.2 to 0.375 liters with different alcoholic mixed drinks. This facility, with a maximum capacity of 21,000 bottles per hour, is one of the filling stations with the most product changes, an average of three times a day. Not only the product, but also the bottle types and their bottle caps change, especially with regard to their color, whereby the closures can have a total of eight different colors ...", explains Timo Hennen, automation engineer at Peter Herres Wein- und Sektkellerei. In order to guarantee a high quality of the bottled products, a camera system had already been in use for several years to ensure the correct fit and thus also the closure of the bottle caps on the bottles.

"However, the system positioned laterally to the conveying direction of the bottles did not always work reliably, so that sometimes defective bottle caps were not recognized. So we decided to look for an alternative. Following a recommendation, we finally contacted ipf electronic and presented our task to the provider of wide-ranging sensor solutions," reports Timo Hennen.

VARYING COLORS AND GLOSS LEVELS

The guidelines from the specification of the wine and sparkling wine cellar included, amongst others, a solution based on a camera sensor that, triggered by a customer's light barrier, should be able to test an average of six bottle caps per second.

"From the past, we knew that a particular challenge here was the different colors of the bottle caps and the accompanying different levels of gloss of the closures. These can cause disturbing reflections during the inspection and may therefore lead to incorrect evaluations. Therefore, we also needed a special lighting, which eliminates such influences as far as possible," says the automation engineer.

SOLUTION WITH APPLICATION SPECIFIC LIGHTING

ipf electronic received some bottle samples with faulty closures for detailed preliminary tests (Fig. 1-3), which ultimately resulted in an **OC53** camera sensor as the optimal solution for the task. This range contains around 40 different contour-based compact units with focal lengths of 10mm, 12mm and 16mm and operating distances from 50mm to 300mm as well as solutions with C-mount lens mount. In addition, the camera sensors differ among other things in terms of number and choice of feature checks, color or grayscale detection, speed and interfaces.



For preliminary tests provided bottles with defective crown corks. On the far right is a faulty closure, which is hardly recognizable neither from above nor from the side, depending on the position of the inspection system. (Images: ipf electronic)

For the specific application ipf electronic recommended the camera sensor **OC539420**, a compact model with 10mm focal length and a resolution of 0.3 megapixels, which allows up to 50 tests per second (with reduced resolution up to 100). The problem of unambiguously identifying bottle caps that differ in their color and gloss level was solved with a special lighting adapted to the application. Although the camera sensors from ipf electronic have integrated lighting, the decision was made in this case for so-called dome lighting, which provides a diffused and shadow-free light.

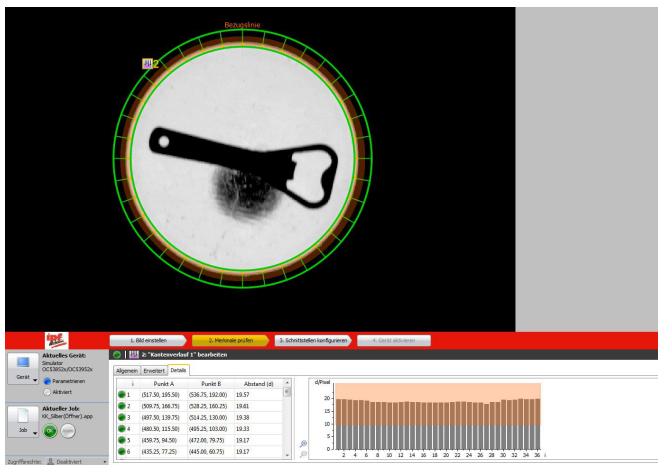
INTELLIGENT PARAMETERIZATION SOFTWARE WITH POWERFUL FEATURES

As is well known, the intelligence of a camera sensor is in its software- and this is extremely versatile in the **OC53** series in terms of feature checks and properties, as confirmed by the application at the Peter Herres wine and sparkling wine cellars.

One of the strongest features of the parameterization software in this context is the feature check edge contours. Thereby the object contour is scanned with several search beams and the determined contour distance per search beam is compared with specified operations. For this purpose, so-called scanning areas of arbitrary shape can be designed, in which theoretically an unlimited number of software-based search beams can be placed. Theoretically, because the number of search beams always has an influence on the evaluation time and thus the response time of the camera sensor.

HIGHLY ACCURATE BY COMBINING FEATURE CHECKS

In the bottling plant of the wine and sparkling wine cellars, the bottle caps on the bottles should be checked vertically from above or the outer contour of the bottle cap should be checked. This is done via an annular sensing area, which was placed over the crown cork's outer contour. There is a total of 36 search beams within this circle.



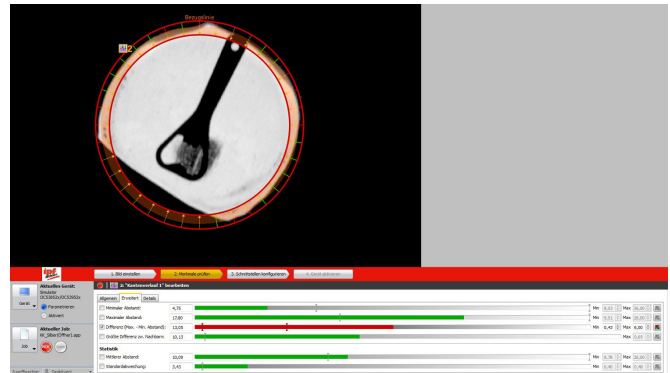
In the feature check edge contours, a total of 36 search beams were created within a circular ring around the closure's outer contour. (Image: ipf electronic)

However, since the bottles and thus the crown corks are not always located centrally in the detection range of the camera sensor during the transport on a conveyor belt, the software also makes use of equally fast and powerful position detection and tracking based on the lid contour of the closure.

"The feature check 'edge control' first ensures that a crown cork is really completely on a bottle. If the outer contour of an incorrectly placed closure is partially outside the annular scanning range, no distance to the crown cork outer contour can

be determined at these points by the search beam(s) concerned. The cap is thus assessed as NIO and the bottle in question is removed from the bottling line after inspection," explains Timo Hennen.

However, if the **OC539420** detects a contour distance over all search beams, an additional check of the crown cork takes place based on a predefined difference value. Here, the distances from the longest and shortest search beam are compared and the difference is generated.



In addition to the position of the cap on the bottle, the crown cork is checked by means of a predefined difference value. In this case, the distances from the longest and shortest search beam are compared with each other. From this, the difference is formed, which virtually marks the measure of ovality of the closure. (Image: ipf electronic)

The difference value thus marks a tolerance range for the permissible out-of-roundness or ovality of a closure. If this is too large, the seat of the closure is not correct and the bottle must be sorted out.

MUCH FLEXIBILITY DURING THE INSPECTION

In order to reliably control all crown corks at all times despite their color differences (a total of eight different colors) during a product change on the bottling line, a separate test program was created and stored for every type of closure using the parameterization software of the camera sensor. If a product change takes place, an employee at the bottling plant simply selects the respective test program via a switch.

NEW POTENTIAL FOR FURTHER ASSIGNMENTS

In spring 2017, Peter Herres Wein- und Sektkellerei put the ipf electronic system into operation, with consistently positive experiences so far. „The camera system works perfectly, detects 100% of all bottle caps and reliably detects all faulty ones, no matter which product is being bottled on the system,“ says Timo Hennen, who has also recognized the potential of the **OC53** for other areas of application in the company. "We now use the camera sensors to check barcodes on packaging cartons. Elsewhere, we use the feature check „edge contour“ of an **OC53** to control the presence of threads in screw caps."



The OC539420 camera sensor detects crown corks of about six bottles per second vertically from above. The device is triggered by a customer's light barrier. Below the sensor, the dome light can be seen, which provides a diffused, shadow-free light. (Image: ipf electronic)

i From a simple monochrome device to a multi-talent

The development of camera sensors shows a trend, which leads- due to an ever greater variety of functions and a higher performance- to an increasingly versatile use of such devices in very different applications. ipf electronic has been offering camera sensors for more than ten years. The first devices of the series **OC70** were introduced at the end of 2006 and possessed after the state of the art only a small image area as well as very limited range of functions.

In the years 2008 and 2009, compact devices with fixed or variable working distances and image field sizes were presented with the **OC64**. Due to the increasing use of IT and software-based solutions in industrial sensors, these sensors for the first time integrated USB and RS232 interfaces. The **OC64** series from the year 2009 proved also due to a variety of measuring functions, a position tracking and a C-mount lens mount for the replacement of lenses flexible in use.

Almost exactly six years ago, the first camera sensor in the **OC53** series appeared. The first further developments of these devices focused on the extension of software test tools in order to significantly expand the range of functions and thus the range of applications in the monochrome sector. With the **OC53** as a color camera in C-mount version, color assessments could be carried out for the first time in 2015 with the introduction of color-specific inspection tools. The **OC53** series is, amongst others, due to its range of functions with numerous feature checks, different position tracking, the control of external lighting with integrated flash controller and different image sensors for higher resolutions, a true all-rounder for highly flexible use in very different applications. The latest innovation is the equipment of the devices with a Profinet interface, while increasing the system speed by up to a factor of 3. In addition, the color cameras were extended to all test functions of monochrome cameras and optimized with the first **OC53** introduced code and text evaluation.