

# Liquid Level Detection for both Blood and Serum



**JADAK**  
A Novanta Company

JADAK Case Study

## **SITUATION:**

JADAK worked with an in-vitro diagnostic medical device manufacturer to create a custom algorithm measuring liquid level. The challenge with this application was that we needed to identify both blood (reddish brown in color) and serum (clear/yellowish in color). Labels on the containers indicated whether the liquid is blood or serum.

## **SOLUTION:**

In order to meet the customer's needs, the following process was implemented:

1. The container is placed in a gripper in the rack. It is spun and images are gathered.
2. Machine vision algorithms are used to determine the type of container and whether they hold blood or serum.
3. The container holder has a gap that enables an image capture of the inside of the container (where the liquid is contained).
4. Another machine vision algorithm identifies the exact liquid level in each container.



As part of the process design, JADAK provided the customer with a recommendation on the container background. The material and position of the container, as well as illumination, can have a significant impact on the reliability of results. JADAK recommended a plate behind the spinner on the backside to provide the background needed for optimal image capture.

Additionally, the container spinning speed impacts the image captured. Therefore, JADAK provided a recommendation around ideal speed in order to use its stitch image algorithm to stitch the image together and provide a complete picture of the label and fluid level. The distance between the imager camera and the container was approximately 145 mm.

### Step One: The Container

JADAK provided two distinct machine vision algorithms to address the customer's application. The first was around identification of the container. Is the container in a rack? Is the container "standard" (2ml or 5 ml test tubes) or "other" (varied sizes and shapes)? Is the container in a gripper spin holder that will rotate? What is the height of the container? What is the cap color?

Below is a photo that illustrates both standard and other types of containers.



To test the accuracy of the first algorithm, 200 samples were run a total of 10,000 test cycles. This provided an accuracy confidence level of 99.99%.

### Step Two: Liquid Level

Once the container type and liquid type were identified, the second machine vision algorithm went into effect. The image of the liquid inside the container was converted to gray scale, with different values depending on whether the liquid was whole blood or serum. In all instances where the liquid level was detected, the level was reported to within an approximate +/- 1mm accuracy level, relative to the reference line.

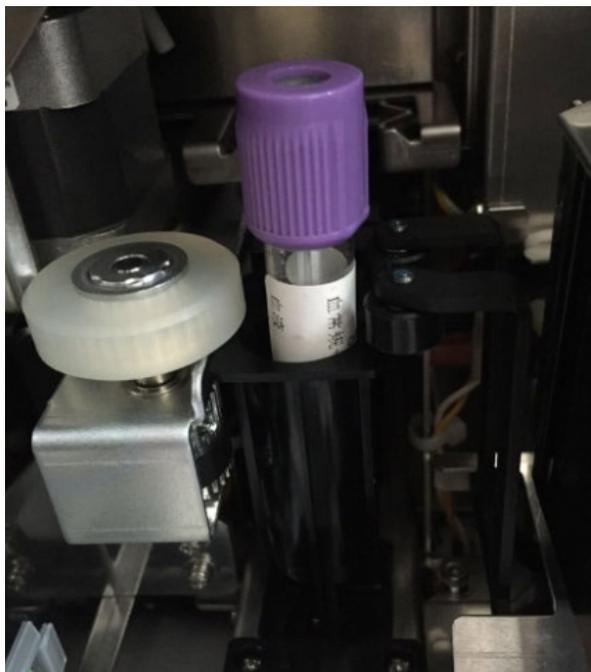
In addition to the level of the liquid, the algorithm identified if there is foam present (true or false reading). To test the accuracy at a 99.99% confidence, 200 samples ran for 10,000 test cycles.

Lastly, the algorithm identified if there was a cap on the container. This is a critical step, requiring 100% accuracy, since an error would result in a broken nozzle once the sample was extracted for analysis.

### Final Hardware & Output

The custom machine vision algorithms were developed using JADAK's Clarity™ Machine Vision software, and then downloaded onto the JADAK SC-6 smart camera, where they were hosted.

In addition to the aforementioned algorithms and as part of the final output of the algorithm, the color value of the cap was provided as a reference for different container groups.



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