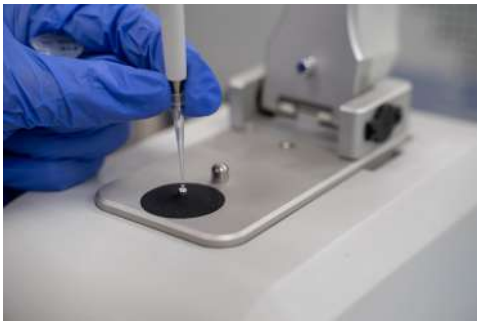
e-con Systems

Think Camera. Think e-con.

Enabling a global leader successfully integrate a camera solution into spectrophotometers



With the demand for molecular analysis experiencing rapid growth, good laboratory practices and quality assurance have become critical. Therefore, DNA analysis and quantification are commonly conducted in these laboratories as a starting point of multiple procedures.

Spectrophotometers play an important role since they quantitatively measure the transmission and reflection of visible/UV /IR light. They facilitate accurate spectral analysis to determine the concentration of the purified DNA, RNA, etc., while verifying its purity before being used in downstream sensitive reaction or assay applications. Air bubbles can be disastrous since they can affect measurement accuracy. The light beam will pass through the air instead of the sample solution, resulting in incorrect absorption.

In cases where micro volumes are analyzed, the detection of air bubbles becomes challenging due to the small size of the sample. Hence, an embedded camera solution can help by imaging the sample and analyzing it for any bubbles before starting the spectral analysis.

About the client

The client is the world leader in serving science and is a Fortune 500 company with years of experience enabling better life sciences research, improving patient diagnostics, etc. They support multiple industry-leading brands across several geographies – with the vision to make the world a healthier and safer place.

Key challenges and customer's expectations

The client was looking for a camera solution to identify the defects (air bubbles) in the test samples before a spectrophotometer application analyzed them. Given that the test sample's size (about 2mm), they required a miniature camera that could accurately focus with high sharpness levels to extract small features from the image. This was essential for driving the product's functionality. Some of the key client expectations were:

- A miniature camera with 5MP resolution
- Macro imaging (25mm working distance)
- Low distortion lens with a FOV of 55°
- Extended camera cable (70mm) to facilitate integration in the mechanical design

Initially, e-con Systems' 5MP autofocus camera module was assessed as a possible solution, given its small form-factor and autofocus capability. However, owing to certain auto focus related challenges, we proposed an alternate solution. Some of the challenges with the available AF solutions were:

- The range of the VCM AF module was only best suited for imaging at a minimum distance of 100 mm.
- Internal VCM movement could result in wear and tear of the VCM spring over time - resulting in inaccurate focus with more usage.
- Additional algorithms should be run on a host to check the sharpness for focus which increases power consumption and thermal dissipation.
- The liquid lens module was too bulky, making it incompatible with the client's mechanical design and increasing the solution cost - a major red flag for the client!
- Refocusing the object for an autofocus solution would be a time-consuming process.

How e-con Systems designed and delivered a hassle-free solution

e-con Systems proposed a solution that comprised a custom 5MP camera module - designed with the right optics and the required cable length (70mm). e-con took care of the focusing and mounting of the lens for the required working distance to ensure accurate and consistent imaging.

Figure 1: 5MP Customized camera module with 70 mm cable

Key areas of the solution design

Selection of optics for close-up imaging:

Macro imaging came with its own challenges, such as identifying a low distortion miniature M6 lens. So, it was crucial to meet the form factor requirements and get quality images while ensuring lens and the image sensor compatibility for optimum performance. The optical resolution and image resolution were also matched to maximize image sharpness and avoid image artifacts caused by under-sampling. It was also important to achieve a good depth-of-field to accommodate for manufacturing tolerances. Typically, M6 lenses come with smaller f-stops, which do not provide a large depth of field.

After conducting several tests. e-con Systems finalized on a M6 lens with an aperture of F2.8 to meet all the optical requirements of the client.

Quality manufacturing to meet tight tolerance limits:

The biggest manufacturing challenge was that these camera modules needed to be consistent in performance when produced in high volumes of about 20K units/year. As this was a fixed focus camera module, the lens had to be mounted and adjusted for best focus

at a 25mm working distance on every camera module. With the F2.8 lens, the depth-of-field (DoF) was only about 2mm, and objects of 2mm dimensions gave no room for error. It meant that the module's focus had to be perfect to produce a sharp, high-quality image.

e-con's manufacturing and engineering team collaborated to set up the manufacturing JIG and software for micro-fine adjustment of the lens with less than 0.5 mm tolerance. With proper validation tools, we helped the client achieve high production yields.

Key techniques in producing consistent yields

- Fixing the cameras with Custom Test JIG to allow for lens mount and focus adjustment
- Pointing the camera towards a custom SFR focus chart for lens adjustment
- Measuring image sharpness for fixing best focus position with diagnostics software
- Lens and lens-mount bonding with moisture-resistant adhesive and curing with UV light

Since even minor movements could change the focus distance, we ensured focus stability by gluing the lens. We tested the camera again after this process to ensure picture-perfect focus.

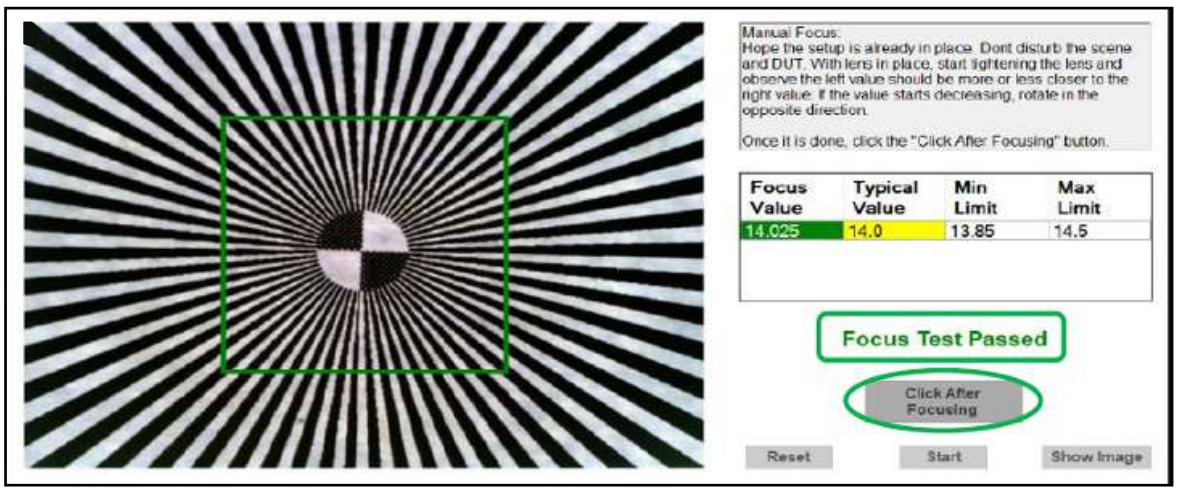


Figure 2: Diagnostic application software for Focus sharpness calculation

Business benefits

e-con Systems' high-quality and reliable camera became a crucial part of the product. It enabled consistent manufacturing quality, which helped achieve high yields and on-time delivery. As a result, the client could harness differentiated business benefits like:

- Producing result data with a high accuracy helped maintain quality consistency in line with world-class standards.
- Improving operational efficiency – saved time by avoiding repetitive analysis
- Increasing workforce productivity

Talk to us

Intrigued by how we used our camera solution and manufacturing expertise to fulfill our client's business-critical needs? Here's a list of great reasons to connect with us right away!

- If you are making any medical devices where the test samples are checked before they are analyzed
- If you need to integrate macro-imaging vision solutions in your medical equipment
- If your current camera partner struggles to provide a 100% tested product with top-notch manufacturing quality resulting in RMAs and without delivery delays
- If you want to build a future-ready vision-based medical equipment/device

Connect with the product manager who worked on this solution:

Balaji S

Email: balaji@e-consystems.com

Phone: +1-408-766-7503

About e-con Systems™

e-con Systems has been a pioneer in the embedded vision space; designing, developing and manufacturing custom and off-the-shelf camera solutions since 2003. With a team of 300+ extremely skilled core engineers, our products are currently embedded in over 350 customer products. So far, we have shipped over 2 million cameras to the United States, Europe, Japan, South Korea and many more countries.

Our cameras are suitable for applications such as autonomous mobile robots, smart agricultural devices, medical diagnostic systems, smart checkouts/carts, sports

broadcasting systems, industrial handhelds, drones, biometric systems, etc.

Our wide portfolio of products includes MIPI camera modules, GMSL cameras, USB 3.1 Gen 1 cameras, TOF cameras, stereo cameras etc. e-con offers a wide variety of cameras with low light performance, HDR, global shutter, etc. These cameras range from a resolution of 2MP up to 18MP.

We are also powered by a strong partner ecosystem to offer end-to-end vision solutions, including sensor partners, ISP partners, carrier board partners, etc.

What sets e-con Systems apart is our deep expertise in building customized product designs while ensuring rapid prototyping and custom modifications in camera hardware and software, including form factor modifications, ISP tuning, carrier board development, lens calibration, and much more.

By empowering machines to see, e-con Systems looks to create a world where humans have enriching life experiences so that they can make the world better.

Giving sight to medical applications:

e-con Systems™ offers end-to-end camera solutions to meet the needs of the medical and healthcare industry. It has a strong foothold in the medical device industry – having empowered clients to integrate unique camera solutions for medical applications in ophthalmology, dentistry, dermatology, laboratory equipment, assistive technology, point-of-care technology etc.

Disclaimer