EFFICIENT MINI-LED QUALITY CONTROL BY AOI SYSTEMS WITH BASLER VISION COMPONENTS

CUSTOMER: MENTO

LOCATION: DONGGUAN, CHINA

INDUSTRY: DISPLAY INSPECTION

IMPLEMENTATION: 2021

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APPLICATION

Mini-LED technology is becoming increasingly popular in both the direct view LED display market and backlighting LCD display market, thanks to its advantages in contrast ratio, response time, resolution, view angle, color space, brightness, and energy efficiency. The new Apple iPad Pro 2021 featuring mini-LED technology is the first large-scale commercial use for the new backlight technology. Since the mini-LED display can deliver big improvements for the new iPad, it has become the most significant display technology innovation to be adopted in next-generation electronic products.

As the mini-LEDs are densely packed to allow for tinier and more tightly controlled lighting zones, the main challenge that looms when mini-LEDs move into mass production is how to manufacture a highly accurate and uniform end-product with minimal deviation, while improving yield and addressing costs. To cope with these challenges, the optical quality control of the mini-LEDs is essential.

Mento uses Basler's vision solution to develop complex AOI systems for visual inspection, defect detection and position recording that can be used throughout the production processes of mini-LED, offering accurate inspection results.

Key inspection tasks for mini-LED quality control processes include:

- Bond testing and inspection to verify bond integrity
- LED chip visual inspection to ensure die adhesion is adequate
- Functionality test for soldering quality

Key challenges in these tasks:

- High resolution is required as chip sizes(<100um) and spacing between bonds (<1.5mm) are very small.
- Multiple image stitching
- High quality color image reproduction and image consistency is critical as different types of defects are to be detected with the help of lightings.



Figure 1: AOI systems are used in multiple production processes of mini LED and in each process, multiple AOI systems are used.

SOLUTION AND BENEFITS

To meet the demands of mini-LED inspection tasks, Basler offered 20MP ace 2 cameras with an acquisition speed of 18fps through a USB 3.0 interface. In addition, Basler customized and enhanced the in-camera features to better suit the case and address key challenges like the requirement for high image quality and consistency, high resolution and fast acquisition speed while producing stable images.

Mento upgraded their AOI systems with the vision solution offered by Basler and applied different lighting solutions to differentiate the parts of the mini-LED to be inspected. Once good and consistent images are ready for comparison and analysis, the AOI system can then make its OK/NG judgement through algorithms.



Figure 3: Defects' coordinates will be recorded for repair

Key benefits of the solution include:

- Lower system maintenance cost owing to the powerful features and market-proven reliability of Basler vision products.
- Flexible and unique customization solutions to fulfill the requirements of a demanding application.
- Reduced system complexity thanks to the small camera footprint and convenience provided by USB 3.0 interface.
- Real-time inspection and recording of defects' coordinates to improve production efficiency and yields.

TECHNOLOGIES USED

- Basler ace 2 a2A4504-18ucPRO
- Basler Cable USB 3.0, Micro B sl/A, P, 5 m - Data Cable
- Basler pylon Camera Software Suite
- Firmware Customization





Figure 2: Scan and stitch an entire defined area in mini-LED chips inspection

Mento's production manager comments: "High accuracy, excellent stability and improved efficiency are the key elements that we are looking for in our vision solution. The inspection tasks for mini-LEDs are demanding due to the small chip sizes, large quantities and a relatively low yield. Intensive AOI testing is required in different production processes to ensure quality. We also need the coordinates information to track pieces that can be repaired to reduce wastage.

After thorough testing and evaluation, we chose to work with Basler because Basler's 20MP cameras are able to stably acquire and transfer images for an extended period of time with high image consistency and low system resource consumption, providing reliable and high-quality images to the software image analysis. What's more, Basler also provided us with a customized firmware solution to enhance image sharpness against the optical limitations we are facing. As well, working with a leading brand like Basler gives our products a further competitive edge."



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