SUMMARY

MOSAIC
MOtion System And Information Control

Customer
MO.S.A.I.C.

Industry
Automotive Manufacturing

Persona
Quality Leader

Challenge
Implement a quality-control inspection system to check brake disks for traces of sand and debris, then remove non-optimal units from the production line.

Benefits/Outcomes
- Custom vision system that detects subtle defects invisible to the naked eye
- Single vision system performs quality assurance for 200+ disk models
- Enhanced quality-control solution reliably removes bad units from the production line
- Standardized inspection process that previously varied due to human review

Solution
Zebra Concord PoE
Aurora Design Assistant™

Brake Disk Manufacturer Refines Quality Assessment with Vision System

Aurora Design Assistant vision software optimizes quality assurance verification with highly efficient algorithms.

MO.S.A.I.C is a global team specialized in robotics and industrial automation with offices in Italy, Brazil, Germany and Serbia. Its engineers have focused on the design, construction and maintenance of vision systems for sectors including automotive, food and beverage, paper, logistics and pharmaceutical production since 2014.

A key inspection system in its automotive vertical conducts surface quality inspections on car and truck brake disks. Though the system had been running effectively with objective human assessment, MOSAIC sought an enhanced quality-control solution to exclude bad units more reliably and effectively from the production line. Its team evaluated several options, and decided upon Zebra's software and components, largely because of the excellent technical support, software features, performance and great price-to-quality ratio its products afford.

The highest quality assurance is integral to the production of brake disks, which are made through a sand-casting process, a metal casting process characterized by using sand as the mold material. After the sand-casting process, disks are cleaned of sand inside a big cleaning drum. Sometimes, the cleaning process is not optimal and sandy residue remains. MOSAIC's system checks for sand and sintering traces on the disk surface, removing bad or non-optimal units from the production line. Sand and sintering debris can damage the machining tool or reduce its life cycle in further production steps.

"With human inspectors, it is natural that product samples, especially those close to the limit between good and bad, will be assessed differently by different operators. The likelihood of these differences increases after humans have worked a few hours and are tired, but with a vision system, in addition to the enhanced quality control, the inspections are repeatable 24 hours a day and the machines perform faster than any operator could."

Marco Pistilli, IT Engineer, Machine-Vision System and Software Developer, MOSAIC.

Perfection Under Pressure

From start to finish, the production process for brake disks encompasses the sand-casting phase, sand removal and disk separation, cleaning/blasting, machine-vision quality inspection and finally, the disk machining phase.

Three people from MOSAIC participated in developing the machine vision project: Luciano Cecchi, a senior expert engineer responsible for the machine design and optical calculation; Pistilli, who oversaw hardware selection/setup and software development; and Alessandro Viola, a programmable logic controller (PLC) expert programmer for the PLC hardware selection and software logic development. "I had the chance to learn new skills by following Vision Academy training, which has proven of tremendous benefit," Pistilli confirms.

To ensure the highest quality standards, the custom vision system was developed and tuned to highlight subtle defects that only experienced quality inspection workers would notice, defects that would be invisible to the naked eye. "Challenges are our strength," smiles Pistilli. "We do what other companies do not want to do because of risks and uncertainty of results. We like challenges." MOSAIC selected flowchart-based Aurora Design Assistant vision software because of its effectiveness, precision and rapid response.

Aurora Design Assistant software runs on an HP workstation equipped with an Intel® Core™ i9 processor and three Zebra Concord PoE frame grabbers, which acquire and process the images coming from nine Teledyne DALSA cameras—seven Genie Nanos and two line scan models. A custom-built lighting system uses MidOpt filters on camera lenses and spotlights. The vision system interacts with a PLC via fast-scan modules and an encoder; hardware triggers come directly from the PLC.

Every camera has a different shooting position; images are captured while the disks pass through the inspection tunnel on the moving production line. "As the system comprises multiple cameras, Aurora Design Assistant is the right tool because of its ability to spread the load over the available CPU cores, and the ability to synchronize all elements of the systems with ease," Pistilli notes. "This flowchart-based software allowed our developers to focus more on achieving our desired accuracy and performance and the algorithm logic, instead of worrying about coding."

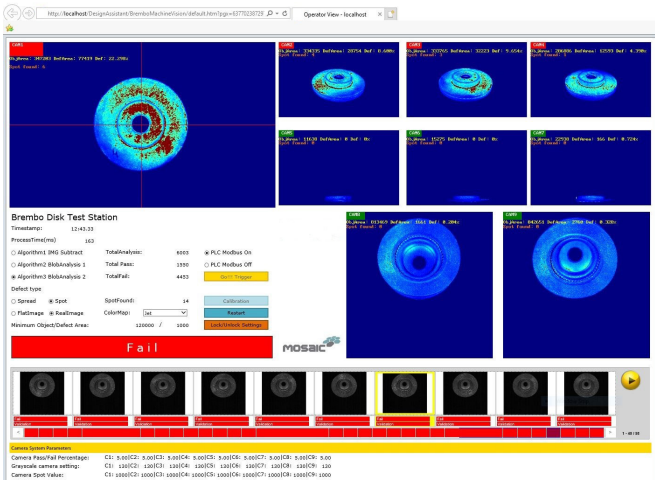
Smoothing the Edges

To achieve its quality-assurance metrics, the team at MOSAIC spent several months testing lighting/camera setups and optimal geometrical constraint combinations. Three challenges were of key consideration.

First, MOSAIC wanted to inspect every angle of the disk surface without stopping the production line or needing to invert or rotate each disk as it passed. The short cycle time made physical displacement of the disk a hindrance to the process, and avoidable through use of multiple cameras. Integrating nine different cameras to catch every disk angle helped address this concern.

The MOSAIC team also wished to conduct quality assurance for more than 200 different disk models using the same vision setup. “We overcame these challenges by developing an effective background removal algorithm to process all the disk models with the same logic and processing algorithm. With this capability, there is no need to redefine regions of interest,” Pistilli reports. “Aurora Design Assistant let us create efficient algorithms for analysis, too, implementing loops and reconfiguring steps dynamically to obtain the best performance results.”

Finally, performing image acquisition with absolute precision was central to the system development. Using the convenient Operator View feature in Aurora Design Assistant, the operator manages recipes and creates different sets of parameters for each camera on the line. Operators can customize the image color-map to best match their needs. A filmstrip allows recall to previous pictures and relative datasets for further analysis. A dataset is generated for each analysis for further investigation from the quality-assurance department. “The user interface is so easy to use, it’s like using a tablet because of the wide touchscreen,” says Pistilli. “The MOSAIC team leveraged the industrial communication tools and implemented fast-scan PLC hardware plus an encoder to get perfectly timed shots,” affirms Viola.



Conclusion

With the new brake disk quality inspection system up and running, the MOSAIC team has started working on a similar project for pharmaceutical laboratory machine automation. “Aurora Design Assistant software allows us to quickly deploy feasibility studies and application demos within the production software,” Pistilli concludes. “The completeness of its tools helps us to work on both 2D and 3D systems. Truly, Aurora Design Assistant offers us all we need to deploy an effective machine-vision system.”

To learn more please visit **www.zebra.com**

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