ENVISIONING HARLEYS

By Richard Daigle, DVT Corp.

Rockwell Automation partners overcome the challenges of designing a machine-vision inspection system to create a no-fail quality control system for the V-Rod motorcycle.

There's life in the old guys yet. With the help of Rockwell Automation partners, two centenarians from Milwaukee — the Allen-Bradley® brand and Harley-Davidson Motor Co. — have joined forces at Harley-Davidson's Vehicle and Powertrain Operations in Kansas City, Mo. The result: a machine vision inspection application for Harley's popular V-Rod motorcycle.

The V-Rod features the impressive 115-hp, 1130-cc Revolution engine, developed by Harley-Davidson in a joint venture with Porsche. Some V-Rods are limited editions that include special 100th Anniversary emblems. All V-Rod assembly is performed at the 330,000 sq.-ft. Kansas City plant that employs 930 people on four lines. Two of the lines are dedicated to V-Rod assembly: one for engine assembly and the other to complete production of the unit. All four of the lines use Allen-Bradley SLC 5/03s.

Allen-Bradley controllers have been on the engine assembly line since it began producing V-Rod engines in 2001. The machine vision inspection application, which has been running since February, connects Encompass Partner DVT Corp.'s 530 SmartImage Camera to the SLC. It looks at bearing and balance shaft presence and proper snap-ring seating in the engine transmission block, and verifies the high quality that is required by Harley-Davidson.

Creativity Required

When Chris Davison of Bachelor Controls, a Rockwell Automation Solutions Provider, got a call about this application, he knew it would be more challenging than the existing snap-ring inspection in place on the V-Rod line. For that inspection, the engine part was positioned on the line in a manner that allowed easy access by the DVT camera. The new inspection, however, involved an engine block in a different position on the line. The working area was too tight for the 112 mm x 60 mm x 30 mm form size of the camera.

"When I first learned of this project, I knew it would require more creativity and resourcefulness than a standard application," Davison says. "This kind of challenge is exciting to me because it can potentially open doors for other applications."

Bachelor Controls worked with Harley-Davidson Manufacturing Engineer Dan Bruyn to come up with an innovative solution. The camera was attached to a servo-controlled linear actuator. The actuator was then connected to a pneumatic slide, with the whole unit able to extend to three different positions to inspect three identical snap rings in different locations on the transmission block.

During the inspection procedure, the camera extends from the home position to the first inspection point, moves back to the home position, moves to inspection point number two, then home, then on to point three. This inspection is performed simultaneously with the assembly of 20 internal engine parts that occurs at that place on the line. (One of the required criteria for the application was that no time would be lost on the line.)

Since the camera could not get close enough to the inspection area, a mirror was affixed at a static position on the pneumatic slide between the press and the engine block to allow the camera to capture images. The mirror had to be positioned at an exact angle for the camera to take precise measurements.

Lighting Issues Solved

Once the pneumatic slide, camera and mirror assembly were complete, the bearing and balance shaft inspections and one of the snap ring inspections worked fine. The position of the other two snap rings, however, created lighting issues that prevented the camera from verifying seating of the snap rings.

After extensive use of the DVT

DVT's SmartImage Camera inspects bearings, balance shafts and snap ring seating in the engine transmission block of the Harley-Davidson V-Rod motorcycle.

Framework "blob" tool and associated software filters, Bruyn and Bachelor Controls devised an inspection process with total repeatability that sufficiently addressed all lighting and image issues. The use of the software filters compensated for the lighting conditions and other issues, so the images captured were of high enough quality to reliably provide all needed data.

Another challenge for the application was identifying a location to be used as a reference point for camera measurements. The snap ring is in the shape of an incomplete circle, similar to a round horseshoe, with two holes in the ring, one on each side of the gap. The first thought was to use the two holes to establish a fixed location. Instead, Bruyn and Bachelor Controls decided to use the gap in the ring as a reference point, measuring two edges on either side of the ring where the gap begins.

After the gap was located, a heavy amount of scripting was required to move the location of multiple line gauges. This involved transferring a spherical coordinate system to a Cartesian coordinate system to offset the lines and ensure that the gauges would hit the snap ring edges in the correct locations.

Using the DVT Emulator tool, which permits users to work on applications offline, the two engi-

neers viewed hundreds of logged images of the application without having to wait for images to come up in the actual process.

"The emulator tool helped immensely, because it meant we did not have to babysit the line as it cycled through. This sped up the process dramatically," Davison says.

Once the machine vision unit was set up, Bachelor Controls added a remote I/O module to the Allen-Bradley SLC 5/03 to communicate to a new remote FLEX I/O rack. They added two power supplies — one for the FLEX I/O and the other for the DVT equipment. All digital I/Os were connected to the DVT breakout board. The DVT breakout board I/O was connected to the new FLEX I/O for station sequencing.

"This controller expansion was a straightforward integration with no major challenges and it has worked flawlessly," Bruyn says.

"Bachelor Controls built a new panel with the DVT I/O board connected to new FLEX I/O and provided the programming for the linear actuator, pneumatic slide, DVT communications and miscellaneous I/O through this FLEX I/O," Bruyn notes.

Now that the machine vision system is performing this inspection, operators save line time and thus have more time to successfully complete other duties. But while this benefit is notable, the no-fail quality control provided by the system is the top benefit.

With a combined two centuries worth of corporate excellence, Allen-Bradley and Harley-Davidson — united by Rockwell Automation partners DVT Corp. and Bachelor Controls — are showing that "old pros" can use the language of quality control to speak to a new generation through the power and style of the V-Rod motorcycle. ABJ

Bachelor Controls:
www.bachelorcontrols.com

DVT:
www.dvtsensors.com

FLEX I/O:
www.ab.com/catalogs/b113/io/1794.html

SLC 5/03:
www.ab.com/plclogic/slc/index.html

Circle 608