Industry Focus: Perfect Vision

P. Lindsay Powell, Business Development Manager, 3M Electronic Solutions Division

Perfect Vision

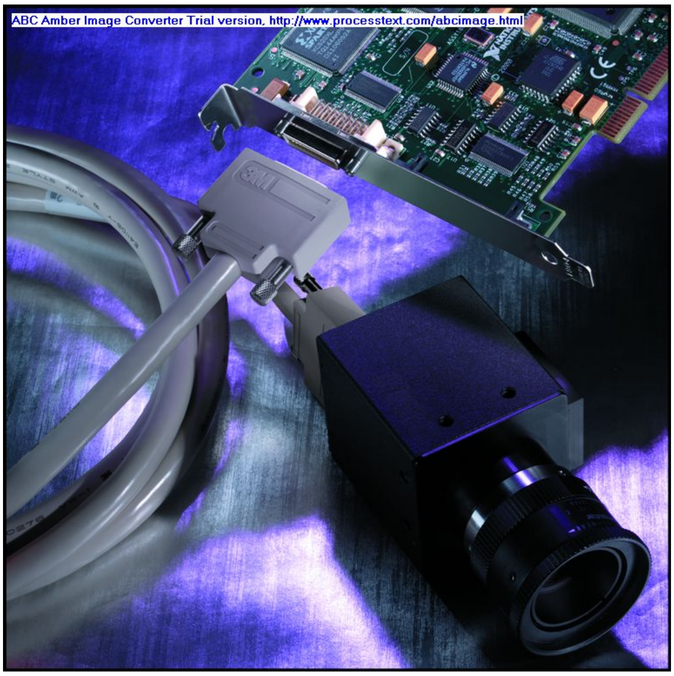
Adoption of the Camera Link standard addresses challenges for machine vision designers.

by P. Lindsay Powell, Business Development Manager, 3M Electronic Solutions Division

In many quality control operations, the human eye has been replaced by the unblinking lens of the digital camera. A machine vision (MV) system is intended for non-contact optical sensing and is ideal for use in quality control (QC) systems for quality assurance (QA). Industries exploiting MV include automotive component manufacturing, electronics assembly, semi-conductor production, food processing and pharmaceuticals manufacturing.

An electronic MV system consists of hardware and software, which automatically receives and interprets images of an object against a pre-determined standard. A camera captures the image. The camera is connected by a cable to a frame grabber – a logic board that turns the data stream received from the camera into a format suitable for image processing. The frame grabber is often PCIbus so that it can be used in a standard PC, but it can also be designed for a card cage system, such as VME. A display shows the images in real time to the human operator.

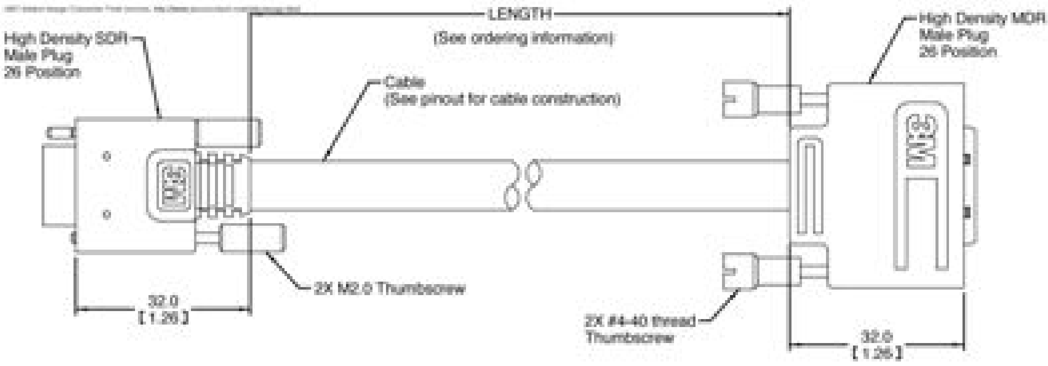
However, in an industrial setting, machine vision presents challenges unique and



separate from traditional camera or PC applications. An industrial machine vision system may endure incessant vibration. Cables connecting the camera to the frame grabber board may have to span long distances. The system elements (camera, frame grabber, PC) may be far apart yet run on low voltage without a separate power source. And, the designer often runs into interconnect compatibility issues.

Some of those design challenges have been addressed by the creation of an industry standard for machine vision connectivity. Until recently, most cameras and frame grabber boards were equipped with proprietary interfaces. Even if the camera shared the same style of physical interface as the frame grabber board, such as D-Sub connectors, the pin-out and wiring configuration between equipment may not have been compatible. The result was systems that sometimes partly functioned or not at all, and a need for ongoing support by the system integration or maintenance/repair organization.

To address this issue, the Automated Imaging Association (AIA) began work in the late 1990s to establish a standard. The result of that industry-wide collaboration was the Camera Link standard, which provides a common communication interface for makers and users of cameras and frame grabbers for MV systems.



Version 1.1 of the Camera Link standard was published in January 2004.

The standard prescribes the transmission method (video data, control signals, communications and power) and the connectors and cabling (pin assignments, mechanical and electrical characteristics) for digital cameras and frame grabbers. The primary benefit of using a common interface is the assured interoperability between compatible equipment from different vendors, reducing support time and cost.

The Camera Link standard is based on the low-voltage differential signaling (LVDS) protocol defined in ANSI/TIA/EIA-644, approved in 1996 and popularized as National Semiconductor's Channel Link platform. LVDS enables engineers to design systems able to deliver clean, high-speed signals over long distances with a low power budget. Channel Link chipsets are capable of data transmission rates up to 2.38 Gigabits per second.

The standard provides for three configurations:

* Base: one Channel Link chip plus camera control plus serial communications (full duplex communication channel, four high speed data lines, four slow speed camera control lines, clocks for LVDS signals) supporting A, B and C ports;
* Medium: two Channel Link chips (full duplex serial channel, eight high speed channels, four drain wires, no camera control) supporting A, B, C, D, E and F ports;
* Full: same as medium but supporting A, B, C, D, E, F, G and H ports.

The Camera Link standard requires fewer conductors to transfer data. Just five pairs of wires can transmit up to 28 bits of data. The low number of wires enabled the AIA to reduce the size of the connector. In collaborating on the development of the Camera Link standard, 3M Company and National Semiconductor worked closely to test and define the performance of high-speed connectors and cables for LVDS transmission.

Appendix D (V1.2) of January 2007 of the standard defines two Camera Link connectors:

* Standard: a 26-position two-row shielded ribbon style connector on 1.27mm (.050”) spacing.
* Miniature (popularly referred to as Mini Camera Link): a 26-position two-row shielded ribbon style connector on 0.80mm (.031”) spacing.

Both styles of connector have 360° D-shaped metal shells that provide protection from EMI/RFI and assure correct orientation prior to mating. The receptacle connectors feature two jacksockets, which receive thumbscrews on the mating plugs, to assure a robust connection in high vibration environments.

Wide industry support of the AIA Camera Link standard by vendors and users greatly simplifies the process of selecting equipment and setting up MV system. QC managers having modest budgets can use the base configuration to build good MV systems, while those with greater means can implement the full configuration to collect and analyze a variety of information in real time. Both can benefit from the availability of off-the-shelf equipment and cables, safe in the knowledge that the Camera Link standard assures interoperability and that the results will be picture perfect.

About the author
Born in Wales, P. Lindsay Powell is a graduate of the University of Aston in Birmingham, England. He has worked for 3M in the electronics industry for over 20 years in Europe and the United States. In his current position, Powell supports new product introductions into the distribution channel. He lives in Austin, Texas.

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