Baumer

Sensor Solutions
Motion Control
Vision Technologies
Process Instrumentation

Application report:

IO-Link Sensors – Innovation with Real Added Value!

The new communications standard IO-Link is providing interesting possibilities for automation engineering. Parameter data can be simply transmitted from the master to the sensor and, in the reverse direction, the sensor can supply process and diagnostic data for the user. The benefits for the user are obvious. The installation, maintenance and service costs decrease and process reliability increases. Baumer shows the enormous potential of this technology with its new IO-Link-enabled sensors.

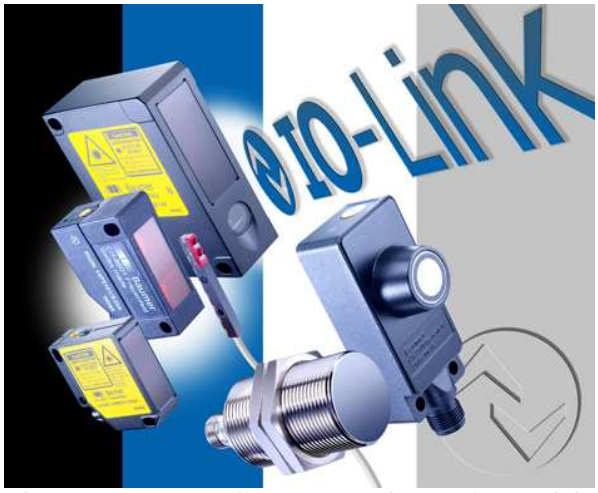

Fig. 1 Baumer offers a variety of IO-Link-enabled sensors from the smallest optical sensor up to distance-measuring optical, inductive and ultrasonic sensors.

IO-Link: Point-to-point connection instead of a (new) bus system

The layered architecture of an automation system follows a path from process visualization via the control system, hubs and gateways, all the way to the lowest layer populated by sensors and actuators. Looking at this architecture shows that various field bus systems for communication purposes have become established in the upper layers. At the lowest level, communications become a one-way street. That is, the actuators receive only the control value from the master while sensors supply their switching state as a high/low signal or, in the case of measuring sensors, the measured signal using a 4 to 20 mA / 0 to 10 V signal to the master. For this reason, 3-wire technology has become established as the standard for sensors. If additional signals, such as the Teach-in input, synchronization input or alarm output, are needed, then the sensor requires an additional contact or another connector, and one or more additional conductors are necessary for the signal-carrying cable.

The consequences are greater complexity in planning; more versions for the sensors, cables and connectors; additional inputs and outputs on the master side and thus higher overall costs.

This is precisely where the new communications standard IO-Link shows its value. As a pure point-to-point connection between the master and the sensor, it is possible in IO-Link mode to transfer serial data additionally by way of the switching output. This is without the described complexity involving special cables, connectors, inputs and outputs, and without having to rely on proprietary solutions that are often high cost.

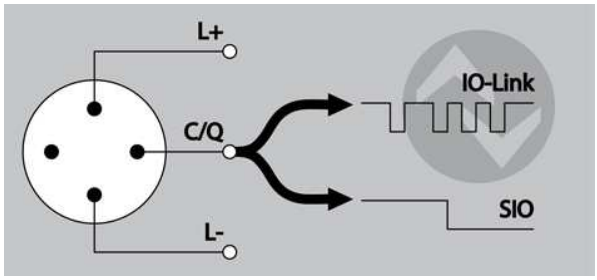

Fig. 2 In IO-Link mode, serial data can be transmitted by way of the switching output.

Consequently, without having to change anything on the connection side, it is now possible to exchange a lot of additional data between the master and the sensor. In this way, primarily parameter data are transmitted from the master to the sensor. In the other direction, process data and, if necessary, even service and diagnostic data are relayed to the master.

Parameter handling

The described method of handling parameters opens completely new possibilities. For example, for teaching the sensing distance, it was necessary first to put the sensor into the Teach-in mode by pressing a button, then to teach the starting point and end point, and finally to finish the Teach-in process. This manual action had to

be repeated for every sensor in the system, even if the sensing distance was identical for each. With IO-Link mode, the sensing distance can now be transmitted from a central point to the sensor without any manual action at the sensor being necessary.

Of course, all parameters can be stored in the control system. If a defective sensor needs to be exchanged in the course of system operation, the sensor is recognized using an identification number, and the appropriate parameters can be transmitted to the new sensor automatically by the control system. Shorter maintenance times leading to shorter machine downtimes are the rewarding result.
In general, parameter settings allow a sensor to be used on a virtually custom-made basis in the most varied environments and areas of application. IO-Link allows the user simply to convert the sensor from light operate to dark operate (and vice versa), to adjust the sensing distance and measuring range, to define the response time of the sensor, the power-on and power-off response of the switching output, or to change the operating mode.
In short, all parameters and functions that the sensor provides can also be addressed simply by way of IO-Link. The benefit for the user is reducing the version diversity of the sensors and consequently providing better warehousing.

Process, service and diagnostic data

However, more information can also be transmitted from the sensor to the master. The process data can be transmitted as was the case up to now as a high/low signal (measured values accordingly as an analog signal). New with IO-Link, these data can also be transmitted cyclically (typically 2 ms) as a data packet. The advantage of this serial transmission method is the increased noise immunity, particularly for analog signals. It should be emphasized in this context that, besides the aforementioned data, more information can be transmitted by the sensor. For example, information about the signal margin, the degree of sensor contamination or alarm signals that are already available in the sensor processor but that have never been routed to the outside because of a lack of output contacts can now be furnished to the master.

It is precisely this diagnostic information that provides a high added value for the user. It indicates whether the process and/or sensor are operating in a stable state. In this way, it is possible to react early and to take appropriate measures. Process reliability and thus system availability and productivity are increased in an efficient manner.

More information = more complexity?

But do these additional features and information also mean increased complexity and cost on the hardware side? This question can be answered with a resounding No. With regard to connections such as cables and connectors, it has already been shown that an IO-Link data transmission system can use unshielded 3-wire/4-wire standard cables and connectors. On the master side, the I/O ports do have to be IO-Link-enabled. In this case, however, the prices that tend to be higher are more than offset by the time saved using IO-Link. Special emphasis should be given here to the fact that mixed operation of IO-Link-enabled sensors and conventional sensors is possible. This means that IO-Link sensors and control systems can be used in cases of doubt only where the added value is useful and actually makes sense. Otherwise, conventional versions can still be used.

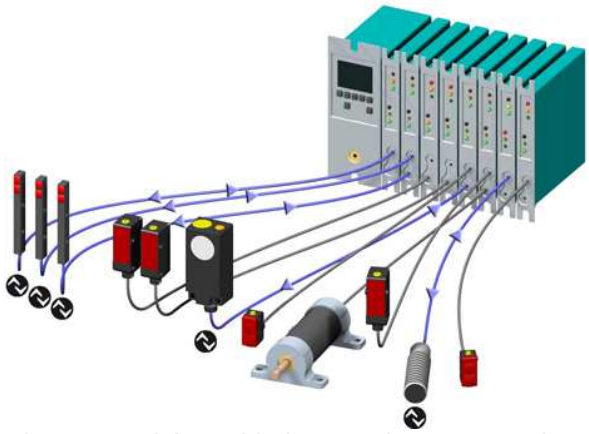

Fig. 3 IO-Link-enabled and conventional sensors can be used together on one master.

IO-Link in practice

The OADM 12 optical distance sensor is used in one application for scanning the winding diameter of fabric rolls. Depending upon the task, different rolls are used and it must be possible to adapt the measuring range limits appropriately for the winding diameter. Thanks to IO-Link, this no longer has to be done manually using the Teach-in mode. Now the new values can be written to the sensor centrally from the control software.
The OADM 12 also supplies the master with more information. As the sensor is exposed to large amounts of dust in this application and this dust collects on the lens, the signal margin drops over time. As a result, the sensor malfunctions,

causing the machine to stop. This is exactly the type of problem IO-Link handles. The sensor signals the master in good time, and provides the user with the possibility of reacting before the machine stops.

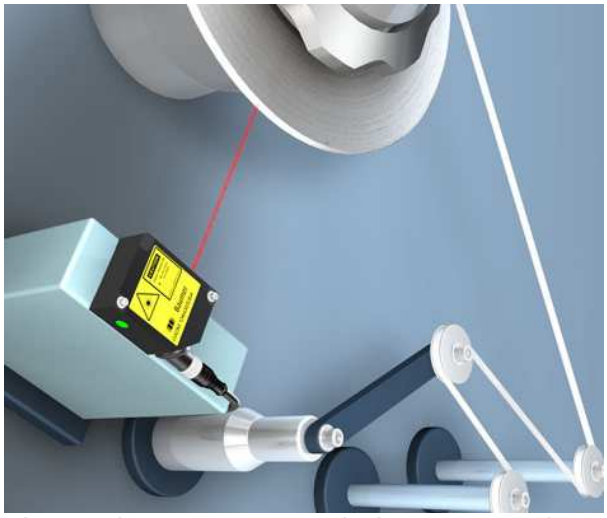

Fig. 4 The OADM 12 optical sensor monitors the winding diameter of a roll of material

Several FHDK 04 optical sensors are used in an application checking for the presence of pills. For simple logic operations, the user can switch the sensors from light operate to dark operate or vice versa from the master, using IO-Link. Even the switching pulse length of the output signal can be set. If, for example, the machine control system uses a sampling rate that is lower than the pulse rate of the sensor when detecting an object, an object may, under certain circumstances, not be detected. The switching pulse length can be adjusted to the desired value by IO-Link, thus eliminating the problem. In addition, using an on-delay timer function for the pulse, it is possible to mask out objects smaller than the desired size.

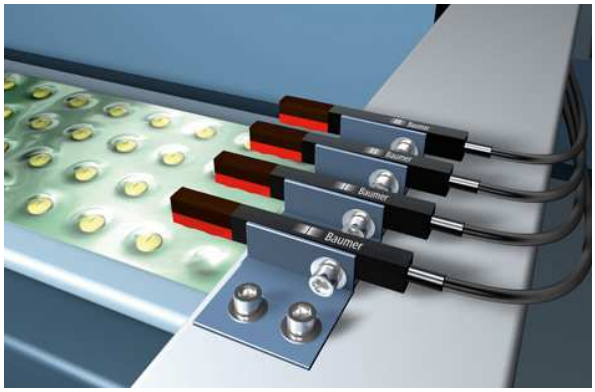

Fig. 5 FHDK 04 optical sensors are used for detecting pills

Ultrasonic sensors are available to provide reliable distance measurement independent of the color or surface finish, for example, for initially positioning a gripper. With an analog sensor, the measuring value is evaluated digitally in a microcontroller and output to the user as an analog signal (4...20 mA / 0...10 V). Then, the machine control system must convert this signal again into digital data to be able to work with it. With IO-Link, the measuring value is also available directly as a digital signal to the user. The transmission of digital signals is less prone to interference than analog signals. For this reason, neither shielded cables nor high-cost analog input cards are necessary for the control system. Furthermore, IO-Link can be used to quickly and easily adjust the threshold switching points and the sensitivity settings of the sensor.

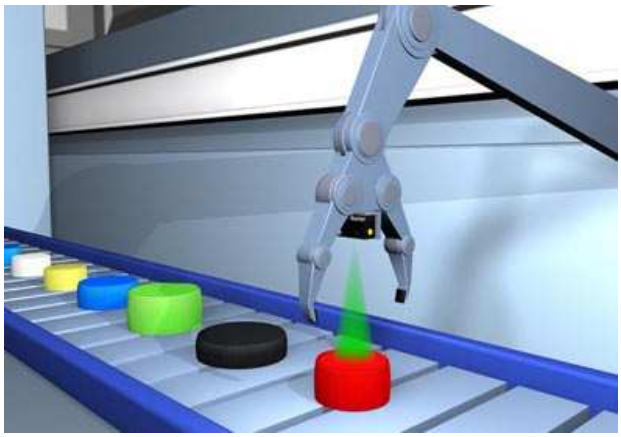

Fig. 6 An ultrasonic sensor is mounted to a gripper and used for color-independent distance measurement.