

Technical Report – Industrial cameras particularly designed for robotics

# Seeing robots

The robotics market keeps on growing – according to a global survey made in 2015 by the International Federation of Robotics, the number of industrial robots is expected to double to approximately 400,000 by 2018. Driven by global competition which dominates industrial production particularly in the automotive and electronics industry, about 70% of the sales volume will be held by China, Japan, USA, South Korea and Germany. Therefore, easy-to-integrate components are of ever-increasing importance in complex robotics systems – both in terms of their mechanical and control integration capabilities. Thanks to consistently optimized design and functionalities, *VisiLine*® IP industrial cameras by Baumer act as the eyes of the robot and significantly contribute towards the above.

Robots and industrial image processing are the “dream team” in cross-industry automated quality checks, inspection tasks and handling applications. They ease human work and raise the consistency of quality inspections in the manufacturing process. In doing so, even complex robotics systems must be as versatile as possible to easily adapt to diverse tasks so they will refund their often high initial costs. Cameras optimally designed for application in robotics limit the number of system components, allow for quick integration by end customers and reduce maintenance effort.

## Status quo: IP 65, protective enclosure and cable routing

Industrial robots usually work under adverse conditions and are exposed to soiling as well as shock and vibration. The components deployed face demanding requirements: They have to be durable, robust and low-maintenance in order to eliminate downtime and production backlog. Therefore, IP 65 is often a “must” – even for the robot’s sensitive eyes. Standard industrial cameras with IP 20/40 protection therefore require a separate protective enclosure. Even if



*VisiLine*® IP cameras with IP 65/67 protective housing are especially designed for robotics.

not solely for camera protection, at a minimum the lens would require protection from soiling or accidental misalignment. A protective enclosure is another system component with all entailed costs for procurement, cable routing, camera installation, inventory and service. That said protective enclosures are a versatile solution for maximum flexibility in various image processing tasks. They allow for easy and application-specific camera exchange under aspects of resolution, frame rate and functionalities and hence will provide the end customer with an ever-optimal price-performance ratio. In addition to cost, another drawback is the high weight of the protected camera and related connection technology which is inappropriate in automation applications. GigE cables and RJ45 connectors used in standard data transmission either provide only notches designed for office supplies or require individualized solutions in the form of threaded connectors, which is an additional procurement effort. The commonly applied Hirose connectors for process interface and separate power supply (rudimentary structure of obsolete analog cameras) implicate high cabling effort. In the global automation industry, M12 or M8 connectors are established. They are available in many standardized variants with a wide choice of international cable types. Additionally, M12 standard connectors are completed by 8-pin connectors with X-encoding to meet the high demands placed on system communication. They are a future-oriented approach for ever-increasing data volumes in vision-based automation tasks. We can take for granted that this connection

technology will firmly establish itself in robotics communication and related control centers for industry-capable data communication, for example via PROFINET. The connector is even capable of 10 GigE data transmission. For the above reasons, protective enclosures are not generally the best and most cost-efficient solution for camera and lens integration in robotics. Furthermore, conventional cable routings and connectors leave room for simplification. Baumer *VisiLine*® IP cameras especially designed for robotics offer an alternative approach by meeting the high demands while forgoing additional protective enclosures.

#### The basis: Automation-oriented design

Baumer specializes in customer and market-oriented implementation of automation solutions. Decades of experience in sensing and encoder technologies have brought synergies to camera and vision sensor design. As an example, all industrial cameras feature M12 or M8 connector and hence match existing cable connection technology thereby reducing procurement effort. In an analog way, the applied I/O levels comply with PLC guidelines. The many actuators commonly used in automation generate interference voltage which may cause unwanted trigger signals. Thanks to the high switching voltage (low 4.5V instead of 0.8V and high 11V instead of 2.4V) they are a reliable solution in overall systems with minimized integration effort even in interference-prone environments. They eliminate the need for external support in servicing and error tracking with the corresponding downtime at end customer sites. With consistent



The threaded 8-pin M12 connector with X encoding and IP rating ensures reliable connectivity to the data interface.

compliance to image processing standards, these industrial cameras are compatible also with many processing libraries and are easily implemented in the most diverse existing applications.

#### The upgrade: Robotics-oriented design

All *VisiLine*® IP cameras by Baumer feature one-box design and meet the aforementioned automation requirements. The industry-capable design is particularly dedicated to robotics applications. The water and dust-tight housing with IP 65/67 rating reliably protects both lens and sensitive camera components. The square housing with mounting capabilities on all sides allows for any installation position and requires only a customer-provided tether. This offers application specific flexibility to the user regarding the optimal camera position – whether from the side or top according to application requirements. The robust mechanical design is shock and vibration proof up to 10 g and 100 g respectively. The user benefits from high reproducibility and failure free operation, even if the camera is attached to the robotic arm and therefore exposed to shock and vibration. A particularly demanding event is a robot's "emergency-off". Such an immediate and sudden stop to prevent personal injury may release high centrifugal force which is transferred to the camera. Installation of both camera and the protected lens must consider such eventualities to ensure a firm hold. Here, the light camera weight of merely 220 g is another product advantage. The modular lens protection system offers high extension flexibility, for example in applications where longer or telescopic lenses are required. The 8-pin threaded M12 connector with X-encoding and IP rating ensures reliable connectivity to the data interface and virtually eliminates potential contact problems caused by moisture. Power over Ethernet (PoE) allows for one-cable solutions in data transmission and power supply which considering the 20 to 30-meter cables typically used in robotics represents a substantial cost reduction in procurement, installation and maintenance. The trigger may be either via PC using the Ethernet line or specific Ethernet command (Trigger over Ethernet, ToE) which with only a few microseconds delay is nearly identical to a hardware trigger. There are different models available with resolutions from VGA to 4 megapixel to minimize application-specific design-in costs of robotic systems. The latest Sony® CMOS sensor generation with 2.3 megapixel and IMX174 is also available. Supplying 50 fps, it leaves almost nothing to desire and provides the resolution most common in robotics.

#### The result: Robust robotic cameras easy to integrate

Image processing-based robotics in a harsh industrial environment place high demands on cameras. When forgoing an additional protective enclosure, a camera which by design is capable to meet the high requirements is required. Baumer *VisiLine*® IP cameras with IP 65/67 housing unite the necessary functionalities with the benefits of flexible and easy integration. Saving integration and maintenance cost, they are the ideal partner in the "dream team" of robot and image processing.

#### More information:

[www.baumer.com/cameras](http://www.baumer.com/cameras)



AUTHOR

**Torsten Wehner**

Product Management

Vision Competence Center

**Baumer**  
Passion for Sensors

Baumer Group  
Phone +41 52 728 1122  
[sales@baumer.com](mailto:sales@baumer.com)  
[www.baumer.com](http://www.baumer.com)