Innovative GigE Trigger Device with Track & Trace

The new Baumer Trigger Device simplifies integration of optical inspection systems based on GigE Vision® because it can ensure for the first time a 1:1 assignment between the inspected object and the captured image during the entire processing chain.

Manufacturers of sensitive products such as e.g. pharmaceuticals must ensure full control over every single product during production. This requires not only the correct assignments between products and packaging, but also their correct labeling and coding. This is achieved by monitoring the entire process with the help of image-processing systems. However, a basic problem of every image-processing system is the assignment of objects and the associated images so that the proper action can be applied to the relevant objects after they have been evaluated. As a rule, light barriers are used to detect the object on the conveyor belt during inline inspection in the production process. Encoders on the conveyor belt provide information on its speed and therefore the position of the object. In accordance with the scenario, a hardware trigger initiates image capturing with the object in the right position. After the image is evaluated, faulty objects can e.g. be sorted out at diverts provided for the purpose.

Clear assignment of the object

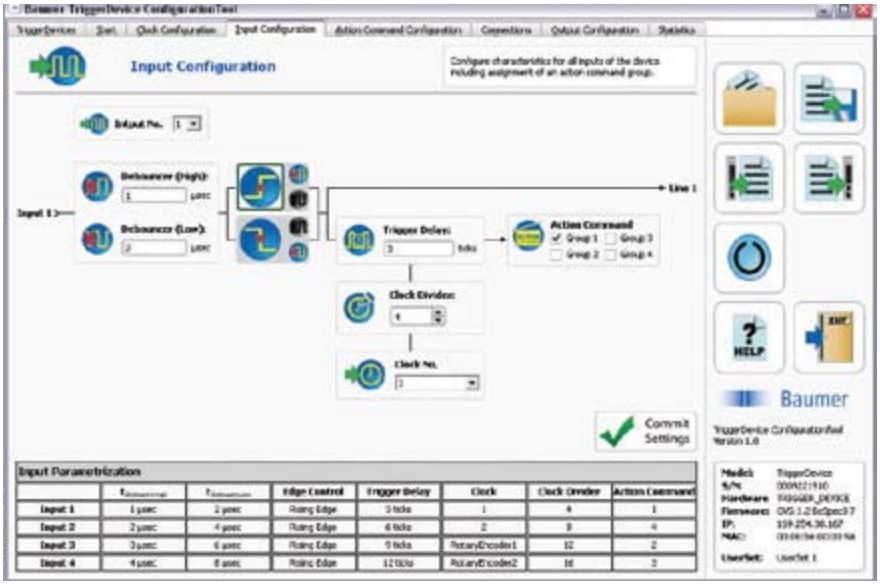
However, currently installed systems often have limitations which can diminish their reliability. For example, objects and their images are not assigned because the camera does not support markings. An application developer must therefore rely on the "first in – first out" (FIFO) assumption. Disturbances can arise if the trigger impulse encounters no image for assignment to the object, or if resends in the GigE net confuse the transmission sequence. This may occur e.g. when a sequence of trigger impulses is too rapid. As a result, it is not always possible to ensure that an object recognized as defective is properly discarded. In addition, the real-time capability is subjected to high demands because both triggering and sorting-out must be performed very exactly and deterministically. This cannot always be achieved by PC-based systems with standard operating systems or commonly used SPS solutions. Moreover, the high complexity of the task requires considerable implementation and testing efforts until acceptable results can be obtained.

Track & Trace with the new Baumer Trigger Device

The innovative Baumer Trigger Device with its "Track & Trace" function addresses these problems comprehensively. It acts as a communication interface at the heart of the process and can assume complete control of an image-processing system. The core component of the Trigger Device is a 3-port Gigabit Ethernet switch. Two of the ports are available for communication while the third internal port is connected to an FPGA. This serves to trigger all cameras in the process. The user has four SPS-conforming general inlets, four clock inputs for encoders and 8 digital outlets at his disposal to link up process-related sensors and actors. The voltage of 24 V and simple, standard DIN-rail installation facilitate swift integration into any industrial layout. The Trigger Device is a network component conforming to GigE Vision® and based on GigE Vision® standard 1.2. For the first time, not only cameras but also so-called non-streaming devices like the Trigger Device can be integrated and administrated in camera nets regardless of their manufacturers. A simple layout with only one camera and a PC can be realized directly via the two Ethernet ports. The Trigger Device supports both standard GigE cameras and Power over Ethernet cameras and permits a single-cable solution with markedly reduced overall system costs. The device can also be expanded for multi-camera systems with a standard GigE switch.

Reliable object tracking

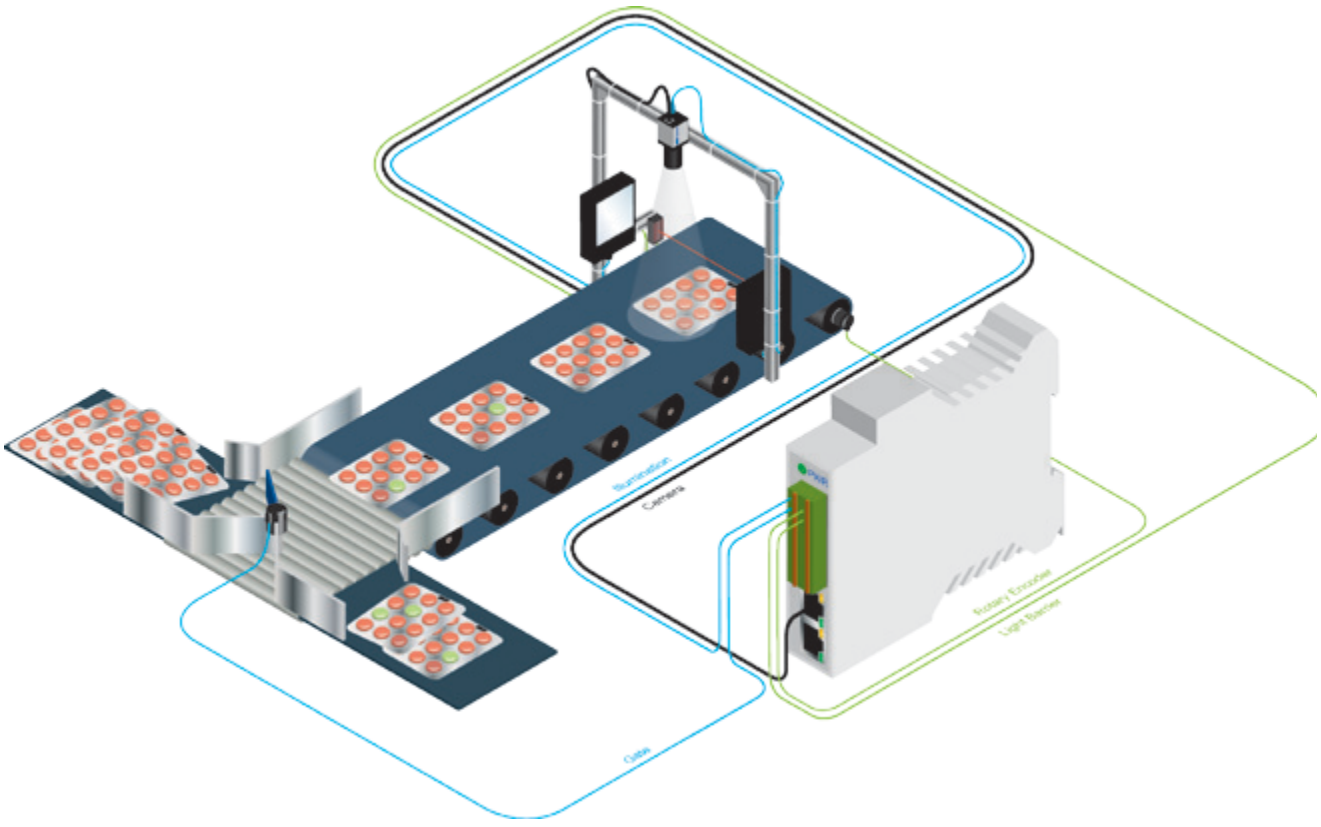
The following example of an application explains how Track & Trace functions. Incompletely filled blisters must be reliably sorted out in this application. The process starts when the object on a conveyor belt is detected by a light barrier. To avoid faulty triggering which can crop up as a result of disturbances in industrial environments, the input signal to the Trigger Device can be filtered by a debouncer and flank control. A clearly identifiable label is then allocated to the object. This procedure is unique in image-processing and allows the object to be clearly assigned throughout the entire process. The Trigger Device can also capture rapid processes because it can administrate up to 512 objects simultaneously. After a preset time or a pre-determined travel path, an action command coupled with the object label is sent to the camera through the GigE net. The camera evaluates the received command and initiates image capturing. The image with the label in the image header is then sent to the PC. After evaluating the image, the PC sends a new action command to the Trigger Device. The command contains the necessary information to perform the action for the inspected object. Transmitting the command along with the label ensures that the desired action will be applied to the right object. The Trigger Device evaluates the command, thereby locating the labeled object and its position on the belt. In the example, defective objects are removed through a divert. This is controlled by setting one of the 8 digital outlets. Here again, a time- or path-based delay can be set to determine when the object reaches the proper position. If image processing does not issue an action command in time, a default setting can be carried out. This will ensure that only objects recognized as correct will be passed on.



Trigger Device configuration

Speeds comparable to hardware triggers

The evaluation of the input signal, the generation of the action command and the evaluation in the camera are completely performed in hardware. Measurements have shown that image capturing can be



Application example

deterministically controlled with a delay of only 8 µs and a jitter of 2 µs. This is comparable to a direct hardware trigger. Since GigE nets are full duplex, sending and receiving do not obstruct each other. However, the network topology should be laid out so that the connection to the camera is used only to control the camera. High-resolution encoders with up to 100 kHz can be used for optimal object tracking. This makes high-precision tracking possible. To attain the required flexibility for different applications, the belt speed of the system does not have to be fixed in advance but can instead be optimized after the system is assembled. The Trigger Device reliably registers even variable speeds or a halted belt.

Configuring instead of programming

While solutions applied hitherto require major programming and consequently demand very intensive maintenance in the event of changes, the Trigger Device is delivered with an easily operable interface for parameterization. Existing devices in the network are automatically located. After a device is selected for configuration, all settings for clock sources, inputs, generation of action commands etc. can be performed intuitively. The settings can then be locally secured and transferred to the device. A portrayal of collected statistics simplifies commissioning. Naturally, the Trigger Device can also be configured by your own software. All required parameters are made available by the generic SDK Baumer-GAPI.

Integration simplified by modern network components

To simplify system integration of its innovative GigE cameras, Baumer offers a PoE injector and several PoE-compatible switches for industrial Vision applications in its GigE Power range. The versatile Trigger Device completes this range. Triggering via the network eliminates the need for the separate cables required until now. A true single-cable solution for the camera is now available in combination with Power over Ethernet (PoE). Aided by the integrated time- and path-based triggering delay, complex requirements can now be portrayed. Thanks to Track & Trace, a reliable assignment between image and belt-conveyed object is guaranteed throughout the entire processing sequence and the PC is relieved of time-critical tasks. The overall complexity of the system can thus be substantially reduced and its reliability can be increased.

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