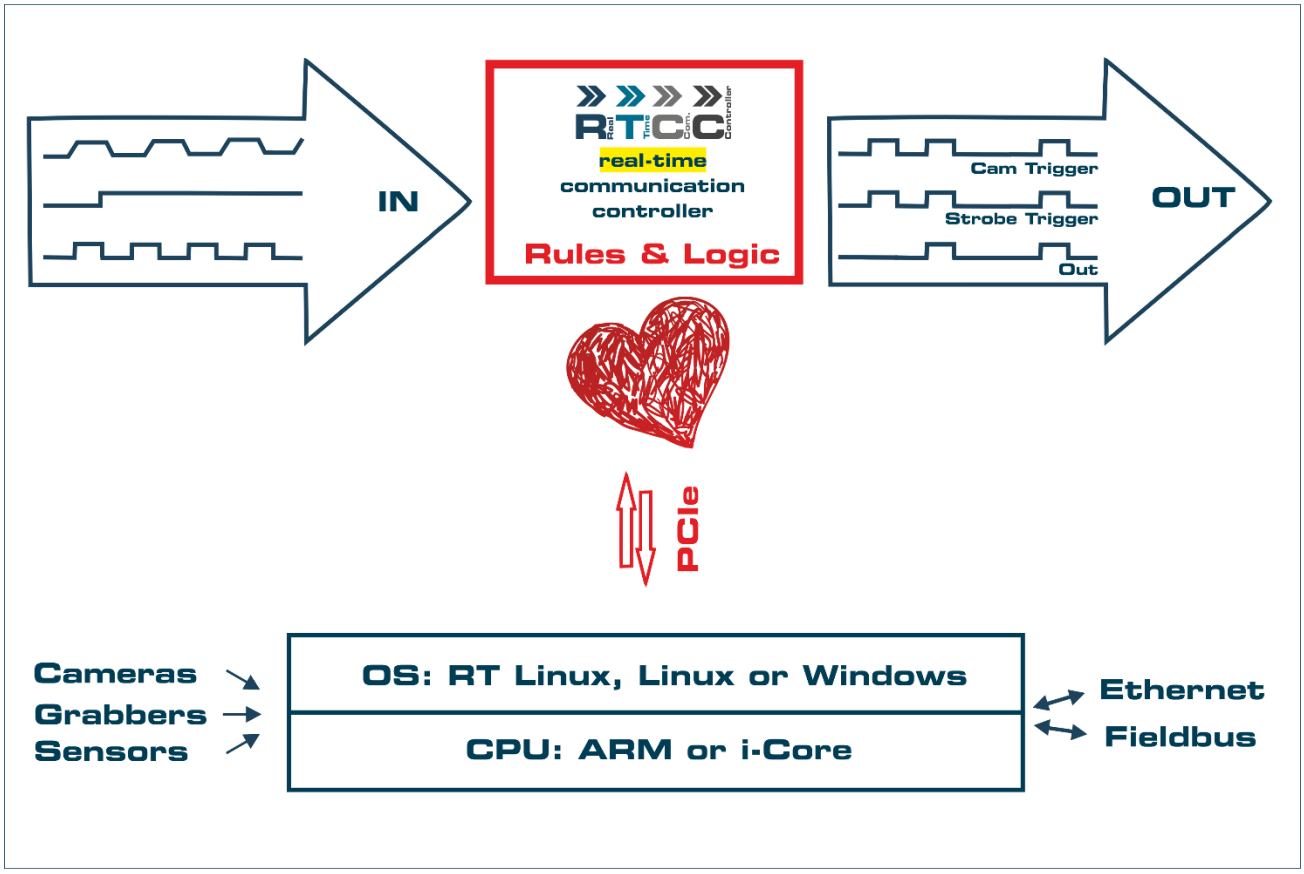
Real-Time Communication Controller



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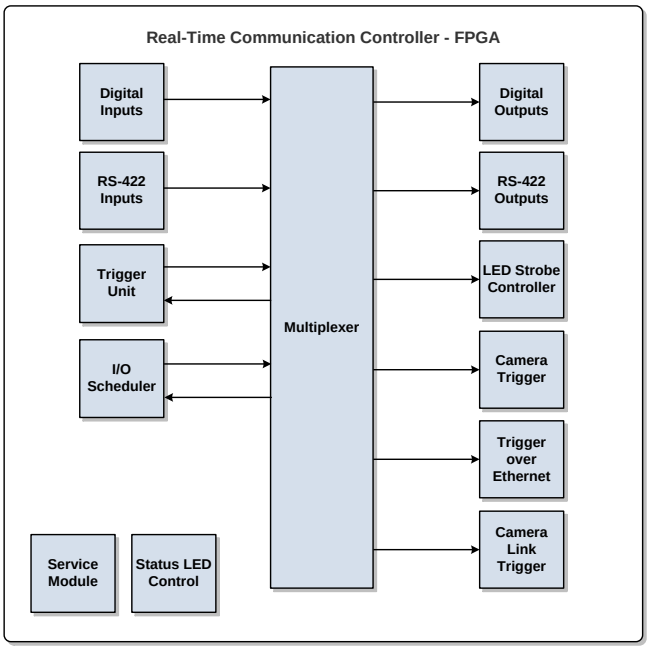
Overview

The Real-Time Communication Controller RTCC is used to control the different VisionBox interfaces in real time. An FPGA device implements the major part of the controller. This allows the RTCC to operate independently from the operating system, e.g. Linux or Windows. Therefore, many applications can be implemented without using a real-time operating system.
Several functional units for handling input and output signals are provided. The user can configure these units during run time using high-level C++ and .NET APIs.



A PCIe interface is used to connect the FPGA to the CPU. Drivers for the operating system are provided by IMAGO Technologies.
The actual number of usable interfaces depends on the hardware configuration. Please refer to the related VisionBox or VisionCam specification.

The following interfaces are controlled by the FPGA:

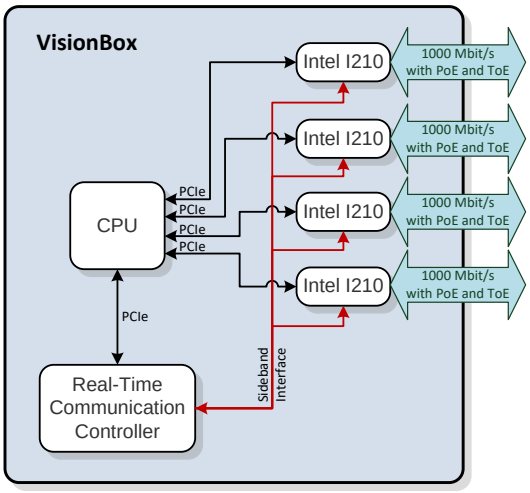
- **Digital inputs and outputs**, optically isolated
- RS-422 inputs and outputs for **encoder signals**
- **LED Strobe Controllers** (current controlled)
- **Camera Trigger**
- **Trigger-over-Ethernet** (GigE Action Command)
- **Camera Link Trigger** (CC signal control)

There are additional internal units available:

- Multiplexer: connects different functional units with each other
- Trigger unit: generates trigger signals which can be derived from other signals (e.g. encoder)
- I/O scheduler: implements a buffer of output values which can be applied to different outputs in real time
- Service module: contains watchdog, system temperature and firmware update functionality
- Status LED control

Real-time Trigger-over-Ethernet

The Trigger-over-Ethernet (ToE) feature is IMAGO's unique real-time trigger for the GigE Vision interface. It makes use of the standardized GigE Vision Action Command. The Action Command messages get generated in the RTCC without any software intervention. The resulting jitter of approx. one microsecond caused by the switching network is acceptable for most applications.
Up to four different Action Commands can be defined by the application. The VisionBox API allows the selection of an internal Multiplexer signal as the trigger source for each Action Command.
In addition, the ToE feature always includes the Power-over-Ethernet feature (PoE). This allows the operation of triggered cameras with just one Ethernet cable:



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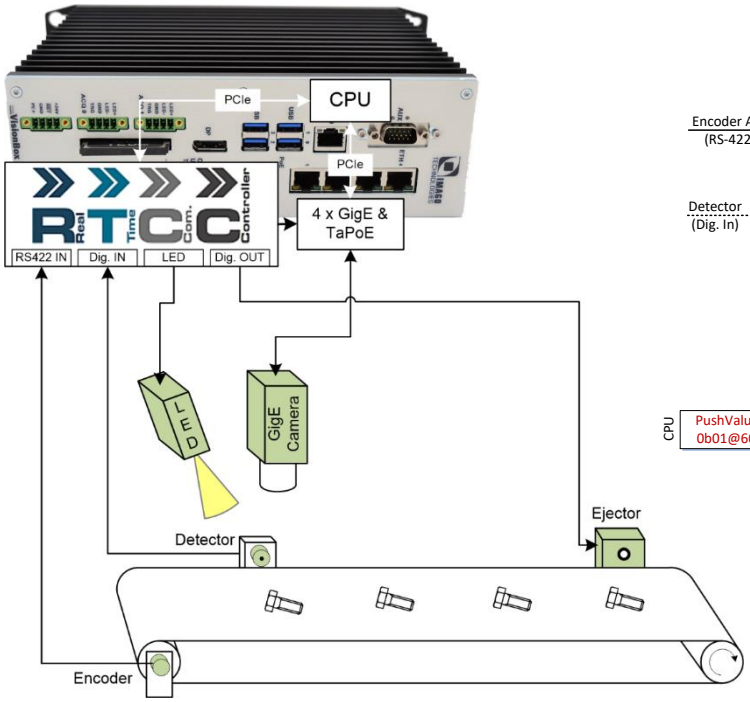
Example Application

Vision system with test objects on a conveyor belt.



Setup

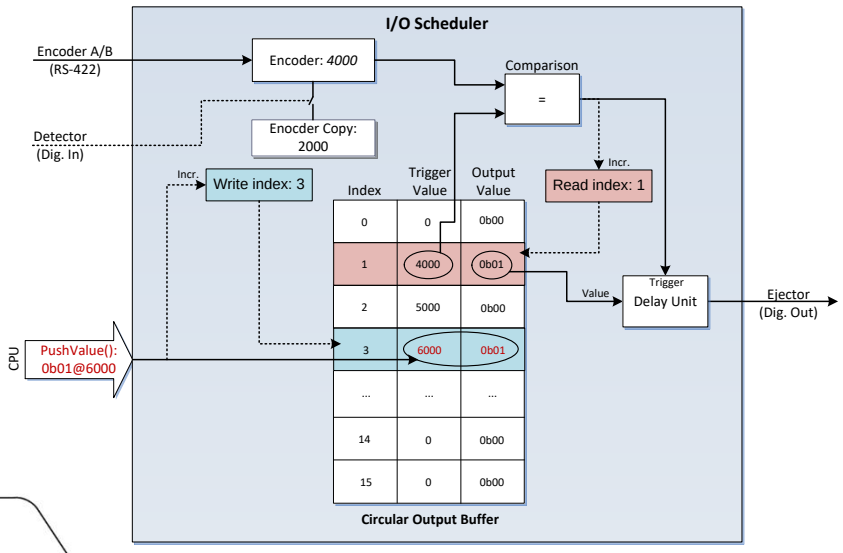
- The VisionBox is used to connect and control all the components of the system.
- A GigE camera is supplied by the VisionBox using the PoE feature.
- A detector is connected to a digital input of the VisionBox. The signal is routed to the GigE interface to generate an Action Command for the camera.
- The LED Controller also uses the detector signal to activate the connected LED light.
- An ejector device for the selection of bad parts is mounted at the end of the conveyor belt and is controlled by the VisionBox.
- An incremental encoder is mounted on the conveyor belt in order to get a reference value for the physical location of the objects.

Possible Challenges

- Speed of the conveyor belt might not be constant.
- Multiple test objects can be located between the detector and the ejector.
- Image processing can take a variable amount of time.

Solution

The I/O Scheduler is used to solve this problem:



First, the I/O Scheduler is configured in the encoder mode.

Each time the detector recognizes a test object, the current encoder location is copied to the Encoder Copy register. Software reads this register after image acquisition to get a reference value for the location of the object.
A decision is made in the image processing whether or not to eject the object. If the object needs to be ejected, an output value of 1 is pushed into the Circular Output Buffer. To calculate the trigger value, the distance between the detector and the ejector measured in encoder lines is simply added to the encoder reference value:

<Trigger Value> = <Encoder Copy> + <Line-Distance> = 2000 + 4000 = 6000

The result is pushed as trigger value into the Circular Output Buffer, together with the output value of 1. Later, the ejector automatically gets activated as soon as the encoder counter reaches the calculated value.
The delay unit is used to specify the length of the output signal.

Please note that the I/O Scheduler can generate multiple independent output signals. For example, the camera and the LED unit could also be controlled by the I/O Scheduler in order to place them somewhere between the detector and the ejector.

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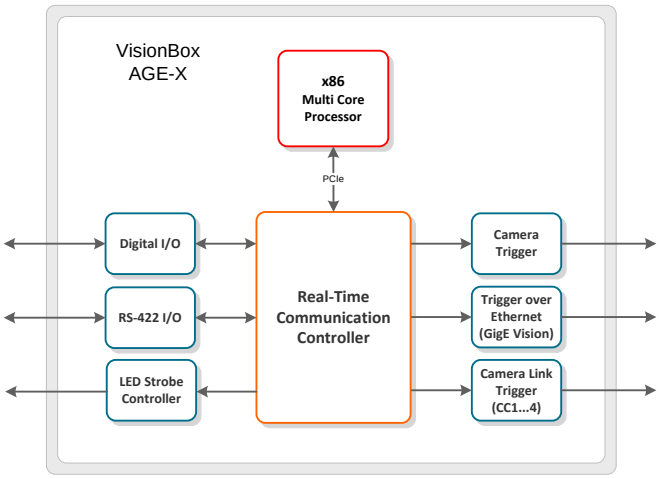
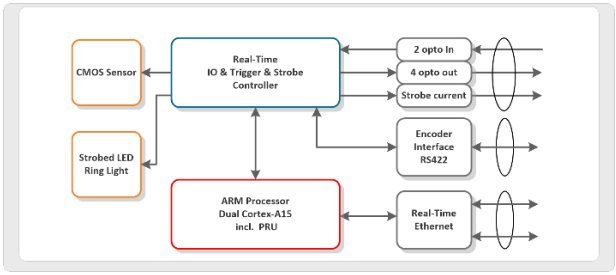
Typical RTCC Interfaces



VisionBox AGE-X



VisionCam XM

Timing in Good Hands

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