White paper

Modern vision inspection with real-time Ethernet

Traditional vision inspection systems often do not allow direct integration into the machine control system (PLC). However, some vision systems have inputs that allow the PLC to send a trigger and outputs for transmitting signals back to the PLC indicating whether the product has passed inspection.

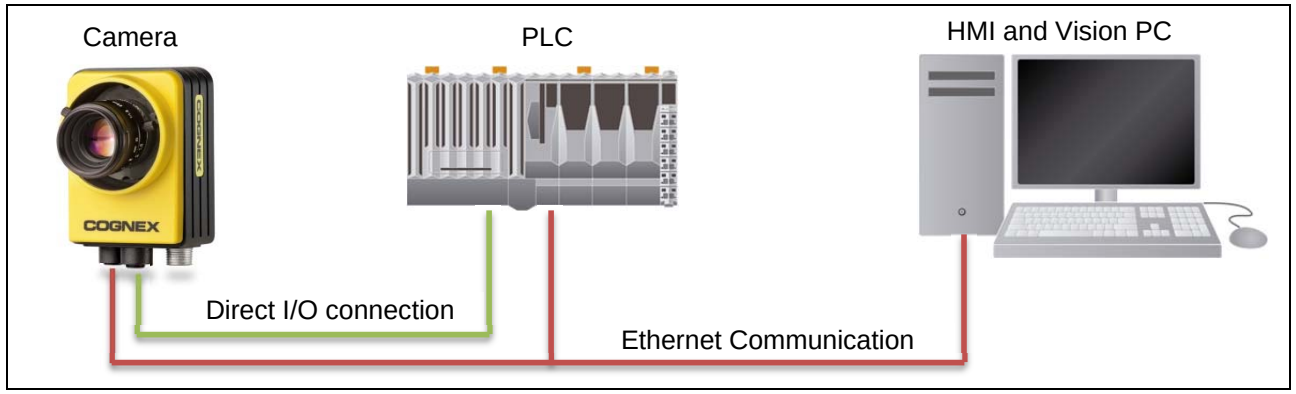


Figure 1: Traditional Vision to PLC system

While this basic interaction may have been sufficient in the past, today's vision applications are much more complex. Oftentimes there are multiple steps within the inspection process that are evaluated as a whole to determine whether a product has passed or not. If a product has not passed it is especially important to know exactly which step in the inspection has failed.

Formerly, to work around this issue, one approach was to open another connection from the PLC to a PC that runs the vision development software. This approach has several downsides. First of all, the machine builder must develop or configure the software linking the PLC and the PC vision software, which adds labor and sometimes license costs for additional required tools such as OPC server and modbusTCP.

Compared to the direct I/O connection between the PLC and the camera the Ethernet based connection is relatively slow and not deterministic. If the machine process depends on detailed data coming from the PC this method can slow down your production cycle. Modern camera systems, however, can handle the inspection completely independently and only need the PC to commission the camera once by creating or adapting the inspection profile (job). So why do we even need a PC in the first place?

Many PLC vendors now support panels that combine a PLC and HMI in a single device. This eliminates the need for a PC that runs the machine visualization. A single development tool is used to create the controls part of the machine, motion, safety and the visualization.

Cognex is the leading brand for machine vision and Industrial ID. Cognex® In-Sight® 7000 series vision systems support POWERLINK. POWERLINK is a deterministic real-time protocol for standard Ethernet. It is an open source protocol managed by the Ethernet POWERLINK Standardization Group (EPSG).

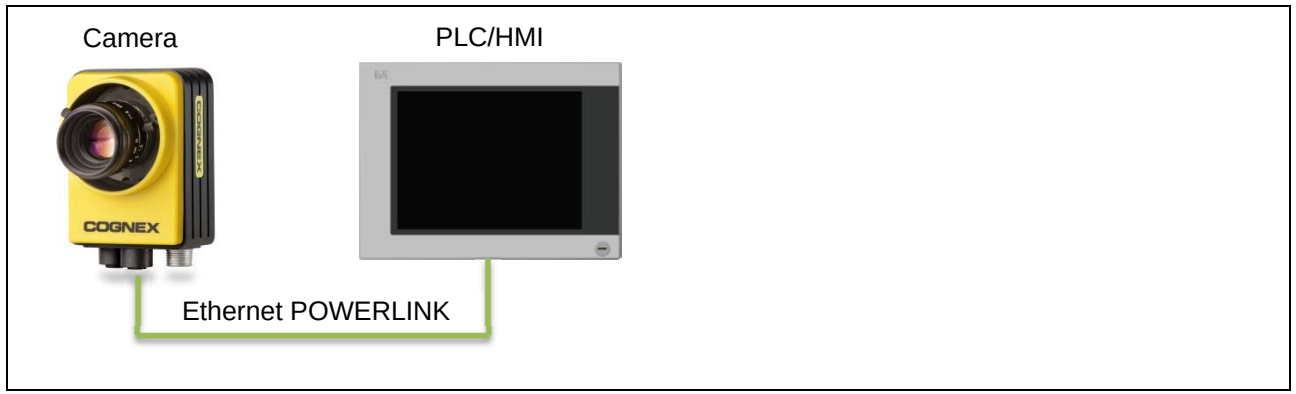
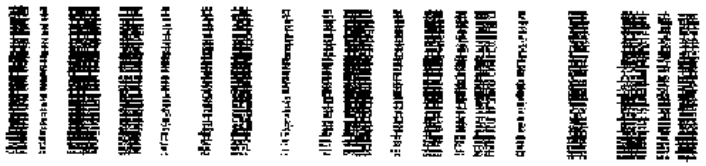


Figure 2: Modern Vision to PLC system

Using real-time Ethernet allows you to transfer not only basic information like trigger or pass. It allows you to transfer pretty much any type of information from the camera back to the PLC. This is very helpful to optimize and troubleshot the vision process in much greater detail.

Reading a barcode is a good example to show the benefits of having more detailed information. The camera not only provides the number code for the barcode, but also information such as orientation, position, or time required to read the bar code. The sampling time will vary depending on the orientation and quality of the bar code. A longer sampling time could indicate that the print quality of the barcode is getting worse. This additional data allows for continuous process improvement to resolve issues such as “no reads” before they impact the production process.



Modern Ethernet based real-time networks not only allow for transferring time-critical data, but also allow non- real-time information on the same network. This is accomplished by splitting the cycle into a synchronous and an asynchronous phase. The synchronous phase carries the time-critical, real-time data. This data consists of analog/digital input and output data, drive positions or safety relevant data.

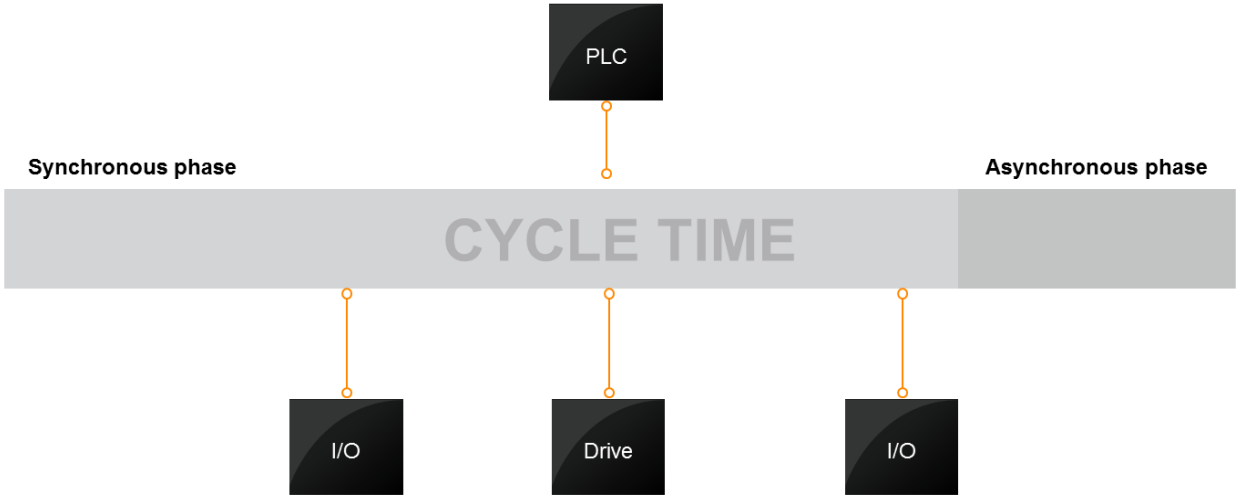


Figure 3: Real-time Ethernet cycle

The asynchronous phase carries data that is not time-critical for the machine process. This data includes firmware updates for modules or drives or advanced status information. Taking the example of the vision system, this data could be an image of the product that the camera transfers back to the HMI. The product image is not something that has to be available in real-time, but might be of value for the end-user to determine why parts of the inspection have not passed the inspection. Looking at the previous example for the barcode, the end-user would get a notification that the barcode read function took much longer than expected. When he looks at the camera image he then sees that the print quality of the barcode has worsened. Another example of a network carrying a mix of real-time and standard Ethernet communications is when the PLC acts as a router.

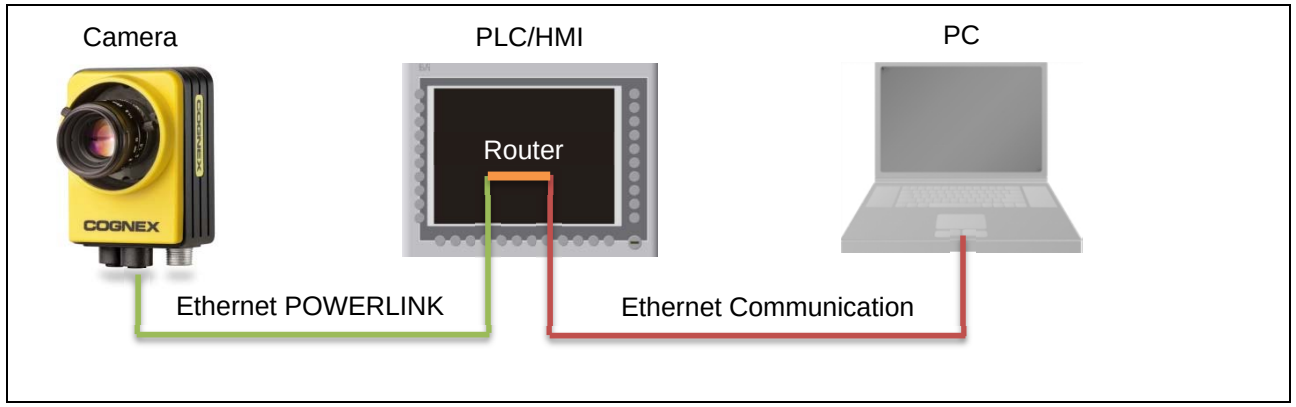


Figure 4: Using the PLC system as gateway

In some situations it may still be required to connect with a PC from time to time. For example, the PLC is capable of uploading and downloading jobs, and sometimes jobs must be optimized on the fly using the vision development software. With POWERLINK the camera can stay online, running the production inspection operation over the real-time Ethernet network while the PLC becomes a router for the standard Ethernet communication. This allows for optimizing jobs and uploading them to the camera without stopping production. It does not affect the real-time network at all and all drives and I/O components will continue to run as usual.

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