Degrees of freedom in automation

Guest commentary Dipl.-Ing. Daniel Pfeifer, published in IEE 1/2023

Decentralized automation solutions are attracting increasing levels of interest. We could add "again", since this trend is nothing new: such topologies have been implemented in the automation world since the late 1990s. What is new, however, is that, in terms of networking, standards developed over the past decade have prevailed. As a result, many proprietary fieldbus solutions are being replaced with standardized ones. This opens up the market, frees users from dependency on one single supplier - and thus secures investments.

The trend towards decentralized automation topologies continues. And the reason is obvious: they can conserve resources and increase efficiency. The increasing complexity and the required variability of products and production processes, as well as ever increasing time and cost pressures, call for appropriate solutions.

Reduced wiring efforts

First of all, decentralized I/O systems, which are usually connected via Ethernet-based fieldbuses, significantly reduce the amount of wiring required, especially for machines and systems that are distributed over a greater distance. The total size of control cabinets is therefore reduced, since corresponding components are mounted on or near machine parts. In the best case, control cabinets can even be completely eliminated. Reduced cabling effort leads to lower personnel costs in production and, in particular, during on-site assembly. And, last but not least, material costs are also decreased.

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Increased efficiency through modularization

Distributing intelligence within a control topology ("decentralized intelligence") makes modular mechanical engineering much easier. Modules function autonomously and communicate via clearly defined interfaces. This makes it possible to test complex installations step-by-step and enables gradual integration with existing machine or system components at the manufacturing plant.

Modularization also accelerates the development process: Resources can be deployed in a targeted manner. Complex tasks can be carried out in parallel, and it therefore becomes easier to build and manage machine variants. At the same time, it is simpler to certify individual modules in accordance with applicable standards, instead of the entire machine.

Faster commissioning, higher availability

The pressure on commissioning engineers and, consequently, on maintenance personnel is increasing: machines must be brought into productive operation as quickly as possible. Downtime must be minimized. Here, too, decentralization offers advantages: individual system parts can be put into operation immediately after testing, even before the machine has been completely set up. Subsequent changes during operation require significantly less time, potential faults are easier to localize, and malfunctions can be rectified more quickly. Consequently, machine availability increases.

Challenge: The right communication standard

Thanks to the availability of non-proprietary, standardized protocols, the often-unpopular vendor lock-in seen in decentralized topologies is now a thing of the past. Nevertheless, the question arises as to which communication standard is the right one for the respective application, and which of the constantly emerging new protocols and technologies on the market will endure in the future. In addition, there is increasing demand for communication protocol security. Certifications according to IEC 62443 have increased enormously, underlining this trend. Safety applications are also steadily increasing. The new EU Machinery Directive, as well as increased collaborative work with robots, justifiably places high demands on a controller when it comes to personal safety, and also on secure networking. This means that future-proof protocols must be equally capable of safety functions.

Condition monitoring as a trigger

Demand for complete traceability throughout the production process are the reason behind noticeable growth in data volumes. In addition, there is also increasing demand for effective condition monitoring solutions for machine components. For this purpose, structure-borne sound sensors and 3D acceleration sensors,

A new generation of decentralized I/O solution was presented by Bachmann electronic at SPS 2022

IN A NUTSHELL:

- *Decentralized automation concepts are becoming more and more important*
- *Intelligent automation topologies can reduce machine development and manufacturing costs and minimize operation and maintenance costs*

placed at critical positions, generate considerable amounts of measurement data due to high sampling rates. For these to be processed in a central control system would require immense bandwidths for data transmission or - as used to be the case - sampling rates would have to be dispensed with. Targeted "edge computing", essentially decentralized preprocessing, is what makes such applications possible in the first place.

Careful balancing act

A cost reduction measure in one area often leads to increasing costs elsewhere. Intelligent sensor nodes, which not only detect signals but also generate data, pre-process it, package it into communication protocols and then distribute it via various (wireless) interfaces, are expensive compared to classic sensor systems. In addition, an intelligent sensor node has higher power requirements than a "simple" sensor. Due to numerous interfaces and cross communication, concepts for a cyber-secure setup are especially important. Careful balancing is necessary and not every IIoT application is inherently useful. There will also be a relevant market in the future for classic sensor/actuator connections to decentralized PLC units, whereby basic automation is realized in the last mile.

Driver robustness

There are often parts of a machine which, at times, cannot be reached at all, or only with immense effort. Or those that operate in extremely harsh environmental conditions. In these cases, reliable integration requires the use of particularly robust components. This is where decentralized automation using tough I/O systems comes into play. More sensitive control components, on the other hand, can remain in protected, easily accessible locations.

Quo vadis automation

Personally, at least for the next 10 years, I do not yet see the widely propagated "vision" of a process chain completely decoupled from the automation pyramid and decentrally automated - from the field/control level via the process control level (SCADA) to the operations control level (MES) and company level (ERP). In my opinion, the engineering, commissioning and maintenance complexity is too high for most tasks. However, I am sure that, now more than ever, the future belongs to the targeted use of reliable decentralized units based on the aspects above.

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