We are IntechOpen, the world's leading publisher of Open Access books
Built by scientists, for scientists

5,200
Open access books available

128,000
International authors and editors

150M
Downloads

154
Countries delivered to

Our authors are among the

TOP 1%
most cited scientists

12.2%
Contributors from top 500 universities

CLARIVATE ANALYTICS

BOOK CITATION INDEX

INDEXED

WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com

Introductory Chapter: New Trends in Industrial Automation

Pengzhong Li

Additional information is available at the end of the chapter

1. Introduction

As a comprehensive technology, industrial automation is a general term for information processing and process control of measurement, manipulation, etc., without direct manual intervention, according to expected aim in machine equipment or production process. Through the application of computer, electronic equipment, control theory, and related process technologies, industrial automation produces the management functions of optimization, detection, control, and regulation of the whole industrial production process to realize the established objectives, achieving industrial production increase, energy saving, consumption reduction, and safe production.

The foundation of intelligent manufacturing is digitalization, networking, and integration. Correspondingly, industrial automation in the era of intelligence will transform centralized control into decentralized enhanced control under the original automation technology and architecture, so that the communication between sensors and the Internet can be seamlessly docked, establishing a highly flexible, personalized, and digital production mode that integrates products and services. In this mode, production automation technology can make equipment more intelligent through self-diagnosis, self-correction, and various functional software to better assist workers to complete production. Therefore, the communication and integration capabilities of automation equipment are required to be stronger, while the automation software needs to have a stronger ability of analysis and processing and data sharing with other software systems of enterprises.

2. Development of modern industrial automation

With the large-scale, continuous, and highly parameterized industrial devices, the requirements for industrial automation systems are constantly increasing. In the era of intellectualization, in order to independently meet the requirements of safe start-stop, stable operation, optimal operation, and fault handling of industrial production systems, it is necessary to seamlessly integrate various instrument products and manufacturing systems into a coordinated information system. Therefore, unified control platform and smooth communication network are the basis of automation in the era of intellectualization. Industrial automation will be further expanded.

2.1. Vertical integration of automation system

Intelligence requires vertical integration of automation system with lower field sensing and data acquisition layer and upper enterprise management system. When the automation system runs, from machine operation, energy use, variable processing to material use, etc., controllers, sensors, and other equipment will produce a large amount of data in every link of the production process. The data from the production site will exceed the business data generated by the company in a few years. It is imperative to combine all the data from the plant operating systems with the information from business applications to create operational intelligence, especially remote maintenance solutions and cloud-based services, to meet the increasing demand for data analysis-based services.

2.2. Horizontal integration of intellectualization-driven automation system

Through intellectualization and its supporting technologies, the control, drive, and low-voltage distribution systems are deeply integrated to form a unified platform for automation integration, which can provide support for scalable motion and machine control in a single programming environment. This integration reduces data storage scale, while the openness of the control platform ensures easy integration with third-party components. How to deal with the data transmission, information sharing, coordinated operation, and autonomous control between these instruments and systems to meet user requirements has become a very important technology—system integration technology. In addition, the visualization and information software used on each machine needs to be standardized. At this time, the application technology aiming at the overall solutions and the application software represented by optimization software and advanced control algorithm have also become the new development trends.

2.3. Networking

2.3.1. Standard open communication network

Vertical and horizontal integration of automation systems requires a unified network infrastructure to establish a standard open communication network to realize the mutual communication between all devices in the system. In the future, network switching equipment will be

more widely used. The application of independent IP enables products and devices to have identifiable independent identities, easy to track, locate, and monitor. In addition, standard communication can integrate more digital devices into the network of production line, such as cameras, RFID readers, digital tablets, safety magnetic cards, and so on, improving the refinement of production management.

2.3.2. Networking of control

There are two components of control system network, namely distributed control system (DCS) and fieldbus control and industrial Ethernet system (FCS). These systems clearly reflect the development direction of the current networked control system, namely, distribution, network integration, and node intelligence. In the development process, Ethernet slowly monopolizes the local area communication in the computer field, and Ethernet and fast Ethernet are gradually unified by the upper communication of process control network. The application of networked control system to Ethernet has become a trend, and the interoperability, digital interconnection, and high open network performance of Ethernet are also in line with the characteristics of fieldbus network control. Therefore, industrial Ethernet has become an important direction for the future development of fieldbus technology.

2.4. Mobile technology

Mobile technology makes management and work flexible. With access to production data and information on tablets or smartphones, factory managers and employees can "move" and communicate with production systems anytime, anywhere. In the future, cloud technology will be used to process and store data from all over the world, and real-time data will be used everywhere. People can contact any relevant personnel anytime, anywhere, and share experience and knowledge with colleagues around the world to solve business problems. No matter where the technical experts are, the call center representatives can consult them in real time, and the experts themselves can visit the history of equipment services and other devices anywhere in the world, as well as check factory updates and other consulting.

2.5. Virtualization

Virtualization reduces dependence on physical servers and other hardware while saving energy costs for factories. Virtualization technology can also improve machine reliability, create low-cost, high-availability backup solutions, and allow multiple instances of the operating system to run on a single hardware. The latest DCS systems have applied virtualized servers to achieve faster processing speed and lower life cycle costs.

3. Conclusion

In the era of intelligent manufacturing, digital twin technology, industrial Internet technology, image recognition, new signal processing technology, and the extreme improvement of

computing performance of control module expand the technical connotation of industrial automation and control objects, and control objectives have also been greatly expanded. At the same time, system modeling technology and joint simulation technology provide new research methods and technical means for the design and optimization of industrial control system. These new technological developments have promoted the development of industrial automation technology to the direction of intellectualization.

Advances on studies for industrial automation have been performed by many researchers, and in the present book, some of them are presented. These advances are focused on some development trends of industrial automation to meet intelligent needs. Although the presented book does not provide a comprehensive treatment by any means to its topics, it is still a very constructive venue to direct readers' attention to some of the advanced trends of industrial automation.

Author details

Pengzhong Li

Address all correspondence to: leepz@tongji.edu.cn

Sino-German College of Postgraduate Studies, Tongji University, Shanghai, P.R. China