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Changes for the Better

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Mitsubishi Electric ADVANCE
Factory Automation

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Precis

Mitsubishi Electric aims to realize Circular Digital-Engineering, and in the FA field, we are working to develop technology that combines "core components" with "digital technology" to create composite value.
This issue presents FA products for realizing this Circular Digital-Engineering, and efforts to comply with laws, regulations, and standards.

Overview

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Challenges and Future Prospects for Realizing Smart Factories from Perspective of Social Trends

"Industry 4.0" was announced in 2011, and various discussions are taking place worldwide to realize its embodiment, the "Smart Factory." In this issue, we would like to consider directions for production sites from the perspective of "monozukuri" (manufacturing) and "mono" (things manufactured).

As the percentage of generation Z and younger population increases, values are becoming increasingly diverse. In response, the manufacturing industry is compelled more than ever before to market many individually customized products within shorter cycles.

There are two ways to respond to this: through product design, or through production methods.

One way of way of employing product design is using software to realize a base for customized features. The approach of broadening product feature variations through software allows for shorter time frames to deliver products to the market and enables speedy and flexible response to individual customization and feature upgrades even after a product's release. Another possible approach is combining customization components with platform products that ensure performance, safety, and fulfillment of basic functions.

For an approach based on production methods, on the other hand, one way is to form an ecosystem. This is the approach of separating into factories that make the previously-mentioned platform products, and factories that manufacture the previously-mentioned customization components and make finished products.

In the manufacturing industry, it is crucial to always advance technology development with a balanced focus on both "monozukuri" (manufacturing) at production sites and information technology.

Visual Inspection Software "MELSOFT VIXIO"

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**Nagoya Works*

Abstract

In automation of visual inspection, AI image inspection is expected to realize more intuitive, sensory inspection of defects that are hard to codify in rules, such as "random scratches" and "uneven color." At present, several manufacturers are starting to roll out products and features that enable AI visual inspection, but there are still various challenges when it comes to adoption.

Mitsubishi Electric has developed the visual inspection software "MELSOFT VIXIO" which solves these problems.

1. Introduction

Today, many inspection processes at production sites still rely on visual checks performed manually. However, due to the global labor shortage, it is becoming increasingly difficult to continue manual visual inspections, and that is driving a growing need for inspection automation.

Against this market backdrop, Mitsubishi Electric has developed MELSOFT VIXIO, visual inspection software specifically designed for Factory Automation (FA) sites. It integrates camera setup, AI model setting, inspection execution, and FA equipment interconnection into a single software package, and enables system building without programming (Fig. 1).

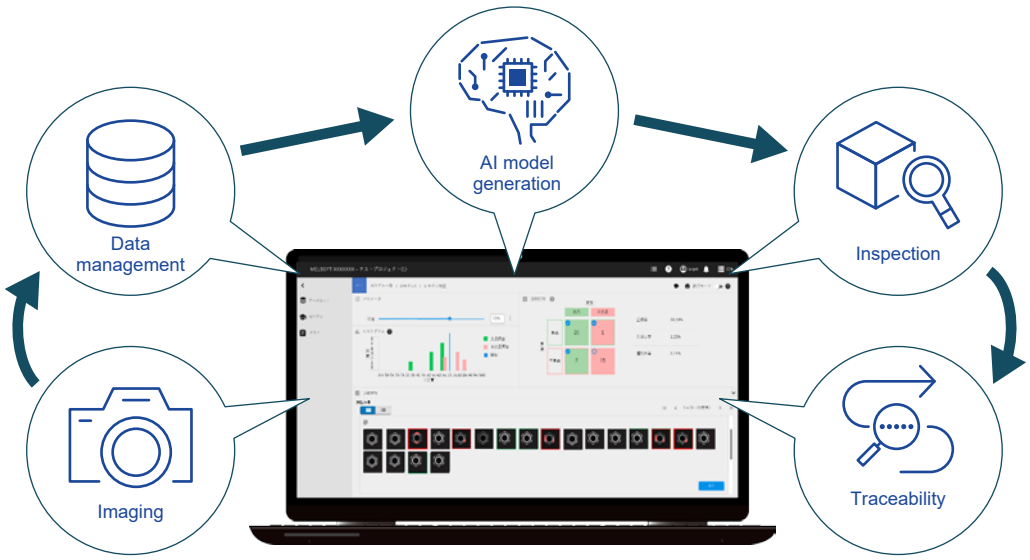

Fig. 1 MELSOFT VIXIO

MELSOFT VIXIO is a software product that allows easy, programming-free development of visual inspection systems for production lines. This product enables programming-free setting of all the essential functions needed to build a visual inspection system, including imaging (camera setup and imaging commands), image data management, AI model generation, inspection execution, and traceability. Furthermore, for AI model generation, we offer AI functions suited to FA sites where collection of images of defects is difficult. These AI functions are: good product training, which enables model generation at industry-leading speed, and abnormal point training, which enables model generation from a single defective product image.

2. Current Issues in the Manual Visual Inspection Process

At present, several manufacturers are starting to roll out products that enable AI visual inspection, but there are still the following challenges when it comes to adoption.

2.1 Customization is needed to interface with interconnected equipment

Typical AI image inspection software tends to lack some features needed in a visual inspection system. In particular, communication with sequencers that handle control at production sites often requires custom programming.

Setting tools for camera imaging also vary by camera vendor, and custom programming using a Software Development Kit (SDK) for camera interconnection is sometimes necessary for inspection system development.

Due to these factors, there is the issue of requiring many person-hours for system development.

2.2 It is difficult to efficiently create high-accuracy AI models

Production sites require high-accuracy defect detection capabilities when adopting AI in visual inspection processes.

Generally speaking, generating a high-accuracy image recognition AI model requires a large amount of image data (hundreds to thousands of images), and training the AI model often takes several hours or, in some cases, even days.

Furthermore, when executing a classification task to distinguish between good and defective products, the standard approach is to prepare images belonging to each class to be detected (good/defective products) in roughly equal numbers. However, defective products occur very rarely on many production lines, making it difficult to obtain defective product images for training in the first place.

In systems that generate AI models, accuracy fluctuates greatly depending on the value of parameters called “hyperparameters” that define the AI model’s structure. Therefore, these values are often adjusted to suit the inspection content. However, adjustment of hyperparameters requires high-level AI knowledge and considerable trial and error, and furthermore an AI model must be regenerated at each adjustment, so setting work becomes extremely troublesome.

Due to these factors, there is the issue that it is difficult to efficiently create an AI model with good accuracy.

2.3 It is difficult to achieve traceability of inspection results

In typical visual inspection systems, the images used for inspection, inspection results (e.g., good/defective product), degrees of abnormality, serial numbers or lot numbers of the inspected workpieces, processing conditions during workpiece production, and other data are usually stored separately. When related data is dispersed in this way, traceability cannot be achieved, and there is the issue that it is difficult to investigate the cause and take countermeasures in the event of defective products being released.

3. MELSOFT VIXIO Features

3.1 Easy system building

To address the issue of needing custom programming to match interconnected equipment, MELSOFT VIXIO enables system building with few man-hours.

(1) Support for common standards for industrial cameras

MELSOFT VIXIO was developed with support for GenICam[*1] and GigE Vision[*2], common standards for industrial cameras. GenICam is a software standard that provides a general-purpose programming interface for all types of cameras, regardless of their interfaces or implemented features. Compliance with this standard allows use of a uniform Application Programming Interface (API), regardless of the interface.

GigE Vision is a standard that connects industrial cameras to computers via high-speed, reliable Ethernet[*3] connections. Cameras and applications that conform to this standard can be interconnected, even if they are products from different vendors.

*1 GenICam is a registered trademark of the European Machine Vision Association (EMVA).
*2 GigE Vision is a registered trademark of the Association for Advancing Automation.
*3 Ethernet is a registered trademark of the Fuji Film Business Innovation Corporation.

With MELSOFT VIXIO, setting is performed using these common standards. Therefore, imaging settings can be completed with MELSOFT VIXIO alone, without using the special-purpose tools of each camera vendor. Figure 2 shows a comparison of camera interconnection settings between a typical visual inspection system and MELSOFT VIXIO.

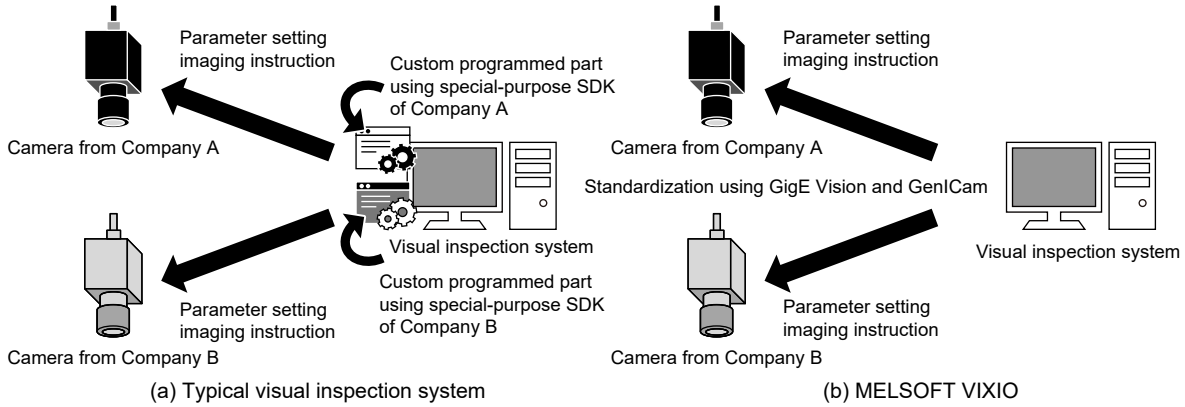

Fig. 2 Comparison of camera interconnection setting

(2) Implementation of the sequencer interconnection feature

Interconnection with Mitsubishi Electric's flagship sequencers, including the MELSEC iQ-R, MELSEC iQ-F, and MELSEC-Q series can be done with just intuitive setting operation.

The system supports interconnection features such as receiving data from a sequencer and using it as an inspection start trigger, receiving process information such as lot numbers and storing that information in inspection records, and sending inspection completion notifications and good/defective inspection results to the sequencer.

(3) Realization of simultaneous multi-person operation through a web application approach

MELSOFT VIXIO employs an approach where a web server is configured on the computer where it runs, allowing users to access the operation screen from a web browser. This allows multiple users to perform operations such as creation of AI models and setting of inspection tasks. Furthermore, by displaying a monitor of inspection tasks on a tablet, use cases are enabled that were difficult to achieve with previous Windows*4 applications, such as ascertaining the status of inspections at any location away from the visual inspection system. The system configuration is shown in Fig. 3.

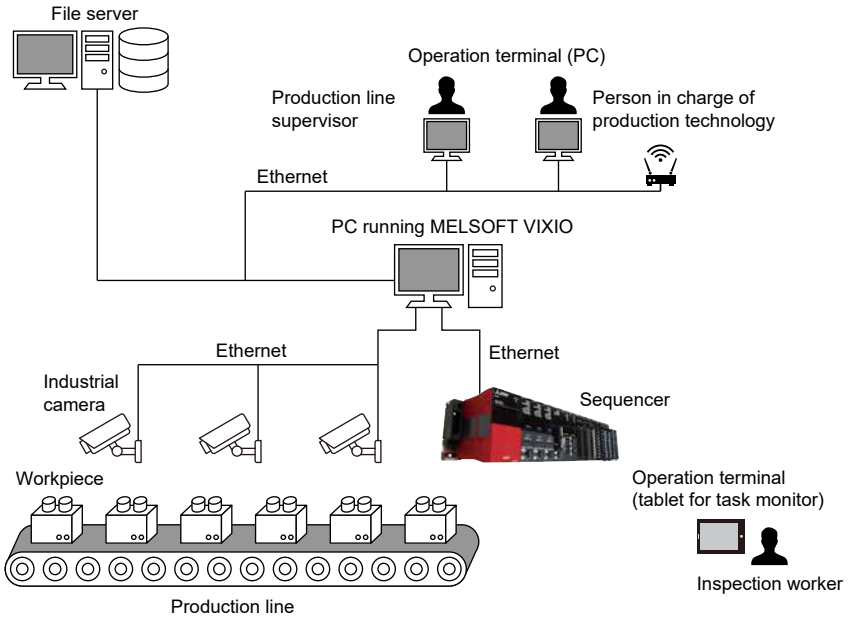

Fig. 3 System configuration when using MELSOFT VIXIO

*4 Windows is a registered trademark of the Microsoft Corporation.

When designing the operation screens, we created design guidelines to ensure consistency across the entire product, along with design examples for screens where usability was a particular priority, prior to the design work for each screen, allowing us to achieve both ease of operation and a refined layout.

3.2 Equipped with high-speed, high-accuracy AI algorithms

To address the issue that it is difficult to efficiently create high-accuracy AI models, MELSOFT VIXIO has implemented a solution by providing two selectable AI algorithms selectable according to the nature of the workpiece being inspected and the frequencies of occurrence of the defects to be detected.

As described in section 2.2, the typical approach when training an image recognition AI model is to prepare hundreds to thousands of images of good and defective products, respectively. However, defective products occur very rarely on production lines for mass-produced products, making it difficult to obtain defective product images for training in the first place.

This issue is solved with the following AI algorithms.

3.2.1 Good product training

Good product training is an algorithm for training using only images of good products. In good product training, an effort was made to speed up training time. Generally speaking, AI training (especially that employs deep learning) often takes several hours or, in some cases, several days, but with good product training, extremely fast training was achieved by optimizing and devising computation sequences for our proprietary lightweight AI to match the hardware architecture.

Furthermore, Graphics Processing Units (GPUs) are necessary in typical AI training and inspection execution, and that too has been a hurdle to adoption. Our good product training realizes training and inspection execution with only a CPU.

As a result, the system achieves high performance requiring 10 seconds or less for training with about 100 training images.

3.2.2 Abnormal point training

Abnormal point training is an algorithm for training using a small number of defective product images. Training can be done with, at a minimum, one defective product image.

Before training, the defective points in the training images must be marked. However, unlike marking in general AI training, precise area selection of defective points is unnecessary, and with MELSOFT VIXIO, marking is done by simply designating the position of the defective point with a few pixels.

3.3 Centralized management of inspection results

To address the issue that “it is difficult to achieve traceability of inspection results,” we implemented a solution by providing a feature in MELSOFT VIXIO to save inspection results (Fig. 4).

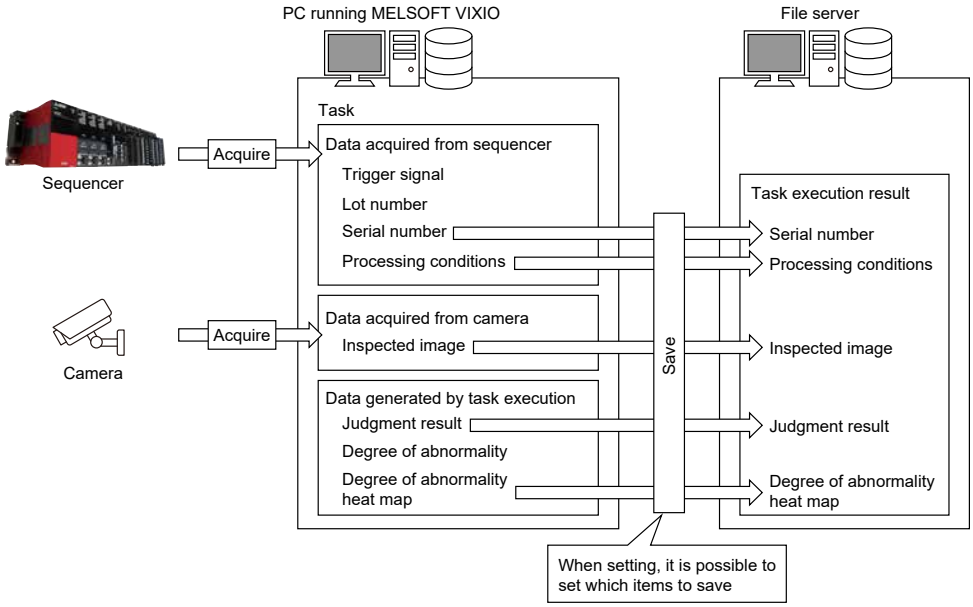

Fig. 4 Saving inspection results

Using this feature, data handled in a task during inspection can be easily linked to inspection results, and saved in task execution units (typically units of inspected workpieces). The serial number, lot number, processing conditions, and other information for the inspection target are obtained from the sequencer interconnected during inspection. The target items to be saved can be selected from the setting screen for saving inspection results, so it is possible to save only the items necessary for ensuring traceability.

4. Use Cases

AI visual inspection systems have rapidly gained popularity in recent years, but it is hard for them to completely replace conventional manual visual inspection processes conducted by inspectors or existing rule-based visual inspection systems.

This section describes use cases targeted by MELSOFT VIXIO.

4.1 Improved accuracy through use together with rule-based inspection

Rule-based inspection[*5] is widely used in inspection processes, but it has the issue that false-positive-detections or non-detection frequently occur for defects whose color, shape, or size cannot be anticipated (i.e., when it is difficult to formulate a rule).

By combining with MELSOFT VIXIO, the strengths of the different methods can complement each other to address this issue, improving accuracy of the visual inspection process as a whole.

4.2 Primary screening of manual visual inspection

In manual visual inspection processes, a system is often used where potential defects such as small scratches or unevenness are sorted via manual visual observation, and items marked as defective in the primary screening are later subjected to detailed investigation by the person in charge of quality assurance. Adopting MELSOFT VIXIO in this primary sorting process makes it possible to perform primary screening of items that may have defects (those that differ from the norm). This reduces man-hours of primary screening and reduces fluctuations of inspection quality.

4.3 Double-checking with manual visual inspector

In processes where inspectors perform visual inspection manually, non-detection sometimes occurs due to differences in skills and experience among inspectors. There is also the issue that checked images do not remain from inspection, so rechecking cannot be done with the image when a defect is released into the market.

By adopting MELSOFT VIXIO to address this issue, a system can be established where AI performs visual inspections, which are then double-checked through manual visual observation based on the AI's findings. This approach can reduce non-detection of defects, and ensure inspection traceability because all inspection results are retained as images.

5. Conclusion

This paper has described the development background, characteristics, and technologies used to realize MELSOFT VIXIO, a system which integrates the features required for a visual inspection system into a single package.

MELSOFT VIXIO reduces man-hours spent building visual inspection systems, and makes a major contribution to ensuring the quality of products. Ensuring traceability in the inspection process also facilitates analysis of the cause in the event that a defective product is released into the market.

Going forward, we will leverage our unique position as a comprehensive FA equipment manufacturer to strengthen interconnection with other products, such as sequencers, Graphic Operation Terminals (GOTs), servo systems, and robots.

This will enable easier construction of high-speed, high-accuracy visual inspection systems, contributing to further automation of inspection processes and improved productivity.

*5 A technique for determining pass/fail by using image processing technology to calculate parameters such as the length or area of specified positions

Compliance for FA Products with Cyber Related Laws, Regulations, and Standards Such as Cybersecurity

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**Nagoya Works*

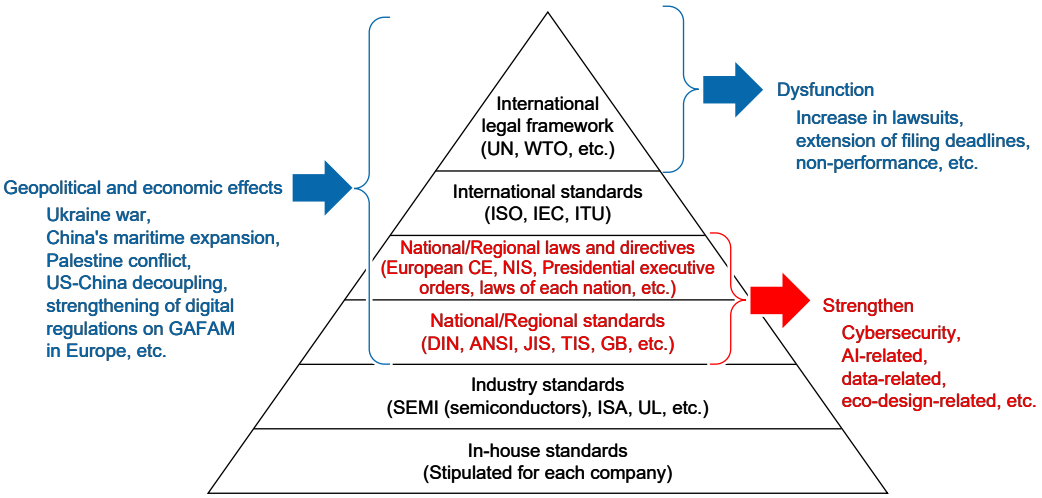
Abstract

At many companies marketing products or services in overseas markets, systems and human resource development are in place for compliance with traditional physical-matter-related laws, regulations, and standards, such as electrical safety laws and the European Directive on the Restriction of the use of certain Hazardous Substances in electronic equipment (RoHS). However, these systems and human resource development are not really adequate for digital-matter-related (hereinafter referred to as “cyber-related”) laws, regulations, and standards in fields such as cybersecurity and AI. This situation poses a risk of escalating into problems that could destabilize corporate management in today’s era where violations of laws, regulations, and standards become major news stories.

Furthermore, promptly and seriously addressing cyber-related laws, regulations, and standards in each country and region can raise the level of corporate competitiveness through various transformations.

1. Introduction

Currently, efforts are underway to digitalize information in factories and offices all over the world through initiatives such as manufacturing Digital Transformation (DX), the industrial Internet of Things (IoT), and the Fourth Industrial Revolution. This digital information can be shared in real-time via the Internet, and that is driving transformations in manufacturing and business models. And social transformation is advancing toward solving environmental issues and realizing well-being—i.e., pursuit of human happiness—through frameworks such as Society 5.0 and Sustainable Development Goals (SDGs).



ISO: International Organization for Standardization, IEC: International Electrotechnical Commission, ITU: International Telecommunication Union, CE: Conformite Europeenne, NIS: Network and Information Systems Directive, DIN: Deutsches Institut für Normung, ANSI: American National Standards Institute, JIS: Japanese Industrial Standards, TIS: Thailand Industrial Standards, GB: Guo jia Biao zhun, ISA: International Society of Automation, UL: Underwriters Laboratories Inc.

Fig. 1 Changes in the impact of laws, regulations, and standards

Amid such major transformations on a global scale, it is essential to establish cooperative frameworks through globalization transcending nations and regions. However, as shown in Fig. 1, recent events such as the Ukraine war, China's maritime expansion, the Palestinian issue in the Middle East, US-China decoupling, and application of the European Union General Data Protection Regulation (GDPR) to the American firms Google, Amazon, Facebook, Apple, and Microsoft (GAFAM) in Europe have intensified the trend of deglobalization driven by geopolitical and economic effects. Critics have also pointed out dysfunction of the United Nations and the World Trade Organization (WTO), which are meant to mediate international conflicts and trade issues.

Amid this international situation, China enforced the Cybersecurity Law of China (hereinafter referred to as the "Chinese CS Law") in June 2017, based on the idea that the Internet too has borders. In addition, cyber-related laws, regulations, standards, and requirements such as the European Cyber Resilience Act (CRA), AI regulation proposals, data laws, and digital product passports are being considered one after another for establishment or enhancement in 2024 and beyond.

In recent years, with the widespread use of social media and the resulting social environment where information spreads rapidly and can lead to public backlash, it goes without saying that even if there are no issues with product quality, a tarnished corporate image due to violations of laws, regulations, standards, or the like can have an extremely large damaging impact on a company's management.

This paper provides an overview and background of the Chinese CS Law, which has already come into effect, and the European CRA, which will come into effect in the future, while also discussing issues that will arise going forward.

2. Chinese CS Law

The Chinese CS Law is a law signed and issued by the President of the People's Republic of China himself to ensure national security by addressing issues such as cyberattacks from overseas, leakage of corporate secrets within China, and the leak of personal information. Many related laws have also been issued, and there has been particular emphasis on three related laws: the Cybersecurity Law, the Data Security Law, and the Personal Information Protection Law.

This law also includes a "reporting obligation," and violations may result in corrective recommendations, warnings, fines, revocation of business licenses, as well as fines or criminal liability for "individuals involved in violations." The Chinese CS Law is also related to national defense, and thus overseas companies cannot ignore the impact of the recently strengthened Counterespionage Law and must comply to ensure the safety of employees working within China.

2.1 Investigative background of the Chinese CS Law and issues

The draft of the Chinese CS Law was issued in June 2015. It was passed and promulgated by the Standing Committee of the National People's Congress in November 2016, and came into effect in June 2017. Products in Mitsubishi Electric's FA field were also included in the Catalogue of Critical Network Equipment and Network Security-specific Products (2017 No. 1, revised in July 2023), which was released at the same time, and Mitsubishi Electric started preliminary research (Table 1).

The biggest challenge for our company at the time was that national standards (Chinese GB standards) had not yet been established for the relevant products under this law, and furthermore, the criteria and assessment organizations for cybersecurity conformity assessment, the organizations ultimately responsible for granting certification, and other details were unclear.

In-house, we had established systems and developed human resources for hardware-related (physical) laws, regulations, and standards, such as electrical safety laws and the European RoHS Directive, which regulates hazardous substances. However, when it came to software-related laws, regulations, and standards for the latest cyber-related technologies such as cybersecurity, our systems and human resource development were still insufficient.

Table 1 Catalogue of Critical Network Equipment and Network Security-specific Products (excerpt from the 2017 No. 1 issue)

Category	Equipment/Product name	Required scope
Critical network equipment	Routers	Throughput (bidirectional) ≥ 12Tbps, Routing table capacity ≥ 550,000
	Switches	Throughput (bidirectional) ≥ 30Tbps, Packet switching rate ≥ 10Gpps
	Servers	Number of CPUs ≥ 8, Number of cores for a single CPU ≥ 14, Memory capacity ≥ 256GB
	PLC	Basic operation processing speed ≤ 0.08μs
Network security related products	Data backup machines	Backup capacity ≥ 20T, Backup speed ≥ 60MB/s, Backup time interval ≤ 1h
	Firewalls	Throughput ≥ 80Gbps, Maximum simultaneous number of sessions ≥ 3,000,000, Number of new sessions per second ≥ 250,000
	Web applications, firewalls	Throughput ≥ 6Gbps, Maximum HTTP concurrent sessions ≥ 2,000,000,
	Intrusion detection systems	Maximum detection speed ≥ 15Gbps, Maximum concurrent sessions ≥ 5,000,000
	Intrusion prevention systems	Maximum detection speed ≥ 20Gbps, Maximum concurrent sessions ≥ 5,000,000
	Secure gateways	Throughput ≥ 1Gbps, System delay ≤ 5ms

PLC: Programmable Logic Controller, HTTP: Hyper Text Transfer Protocol
Source: Information released by China: Catalogue of Critical Network Equipment and Network Security-specific Products (2017 No. 1)

2.2 Response to the Chinese CS Law

We formulated a compliance plan for the relevant products while inquiring with the Chinese standardization committees drafting standards for this law (SAC/TC28, TC260, TC124) as well as with candidate assessment and certification organizations. This plan includes addressing the requirements stipulated by the Chinese CS Law, projecting the timing for assessments and certifications, and arranging assessment equipment.

Also, measures were taken such as establishing a system for collaboration between a Product Security Incident Response Team (PSIRT)[(1)] (an organization responsible for improving the security level of products and services and responding to incidents company-wide), Chinese locations, and sales locations; and assigning and training specialized personnel in both China and Japan.

In March 2018, the “List of Organizations Conducting Security Assessments and Certifications for Critical Network Infrastructure Equipment and Network Security-specific Products (First Edition)” was published, and this clarified the relevant organizations. This list included organizations that we had already considered as candidates. Early establishment of relationships with these organizations facilitated relatively smooth assessments and certifications of the relevant products. This underscores the significant value of the preliminary research that started in 2017.

Also, between December 2022 and October 2023, GB standards (technical requirements and testing methods) for the relevant products were published, and we expressed opinions via local offices to help optimize the standards being formulated. Acquisition of this certification proves officially that the product has implemented appropriate security measures in compliance with relevant Chinese laws, regulations, and national standards. It has the advantage of allowing promotion of the product as government-certified to business partners and users.

Initially, in 2017, the grace period for obtaining product certification was until January 2019, but this was postponed to July 2023 or later. The current situation is such that, as a rule, products that have not acquired certification cannot be sold in China. Moreover, since such products are not listed on the Chinese government’s procurement list, they cannot be sold to state-owned enterprises, which are said to influence 20% of Chinese companies. Our relevant products in the FA field completed assessment and obtained certification by June 2023.

3. European CRA

The European CRA is a law that will take effect within the legal framework of the European region. Aside from exceptions, the scope is broad, “covering all products with digital elements.” Also, as EU directives are revised and approved in a form compliant with the CRA, meeting CRA requirements will become essential for obtaining “CE marking” on digital products.

Additionally, there are reporting obligations of incidents and vulnerabilities, and products cannot be sold in the EU market without fulfilling that obligation.

Furthermore, as a penalty for violations, strict regulations impose fines of up to €15 million or 2.5% of the company’s total global revenue, whichever is higher.

3.1 Investigative background of the European CRA and issues

As part of efforts relating to cybersecurity in Europe, the NIS Directive came into effect in August 2016, aiming to improve risk countermeasures for networks and information systems, strengthen incident response capabilities, and improve the level of safety. Also, the General Data Protection Regulation (GDPR) came into effect in May 2018. In June 2019, the EU Cybersecurity Act came into effect to strengthen the authority of the European Network and Information Security Agency (ENISA), and establish a cybersecurity certification system.

Up to this point, mandatory requirements regarding the cybersecurity of specific digital products had not been included. However, in September 2022, the European Commission released a draft of the European CRA, which listed critical digital products categorized into Class I (low risk) and Class II (high risk). Our relevant products in the FA field were included in these classes, and we began preliminary research (Table 2).

Table 2 Critical products with digital elements (excerpt from European CRA draft)[*1]

	Product name
Class I (low risk)	20. Microcontrollers, 21. ASIC and FPGA, 22. PLC, DCS, CNC, SCADA, Industrial Automation & Control Systems (IACS) (other than Class II products)
Class II (high risk)	7. Routers, modems, and switches for industrial use, 12. PLC, DCS, CNC, SCADA, Industrial Automation & Control Systems (IACS), 14. Robot sensing and actuator components and robot controllers

ASIC: Application Specific Integrated Circuit, FPGA: Field Programmable Gate Array,
DCS: Distributed Control System, CNC: Computerized Numerical Control,
SCADA: Supervisory Control And Data Acquisition, IACS: International Annealed Copper Standard
*1 Relevant products are expected to be subject to review when the European CRA is promulgated
Source: European public information: Critical products with digital elements (European CRA draft)

Currently, the trilogues (three-way dialogues) between the European Commission, Parliament, and Council have been completed, and preparations are underway for promulgation in fiscal 2024. In addition, while the aim at the draft stage was for “product application” to take effect by the end of 2025, adjustments have been made in the trilogues toward some delay. However, a geopolitical issue arose in February 2022 (the war in Ukraine) and many Ukrainian infrastructure facilities actually suffered cyberattacks so the need for early implementation of this bill remains unchanged.

Incident and vulnerability “reporting obligations” are expected to take effect earlier than “product application.”

3.2 Response to European CRA

In January 2023, a public comment period was held for the draft, and in cooperation with the Japan Business Council in Europe (JBCE)[(2)], which represents Japanese industry in Europe, Mitsubishi Electric also submitted opinions and made efforts to influence the process. We pointed out issues such as the difficulty of complying from overseas with the 24-hour reporting obligation to ENISA due to time differences, and the lack of clarity regarding the definition of the starting time for reporting.

At present, we are leveraging our experience with Chinese CS to build a system that includes our Head Office, while listing up our company’s digital products for the European market and considering how to

comply with the main requirements of the European CRA indicated below for relevant products.

(1) SBOM response

A Software Bill of Materials (SBOM) is a list of software components such as Open Source Software (OSS) included in a product, as well as their dependencies. Using an SBOM enables visualization of vulnerability risks latent in the supply chain.

(2) Compliance with reporting obligations and vulnerability mitigation

Centralized management of incident and vulnerability information is required, along with a reporting system to ENISA, and a product/service development organization that enables rapid response to vulnerabilities in products and services.

(3) Response for products and the development process

Standards such as IEC 62443-4-1, which prescribes a secure product development process for components and a security response process for the entire lifecycle, and IEC 62443-4-2, which specifies security technical requirements for industrial control systems, have been put forward as leading standard candidates.

Care is needed because there are many requirements other than these. Furthermore, even after promulgation of the European CRA, there have been many uncertainties, such as the harmonized standards to be complied with for specific conformity assessment methods and the like, and the impact on related laws and regulations (such as the AI regulation proposals, the Machinery Regulation, and Radio Equipment Directive). Therefore, efforts must be made to continue gathering information until the law comes fully into force.

4. Future Issues and Response

In Europe, in addition to the European CRA, steps such as AI regulation proposals, data laws, and digital product passports are being considered, and similarly, new or strengthened cyber-related laws, regulations, and standards are also being discussed in countries such as China and the US. Some of these, such as the Chinese CS Law, have already started to come into force. Taking into account the grace periods before penalties are applied, many of these will require compliance in stages by around 2030.

However, the examples of response described in section 2 and section 3 by no means went smoothly. In addition to the fact that these are new cyber-related laws, regulations, and standards, separate responses are required in each country and region. The departments in charge of the relevant products did not have enough capabilities and the resources to gather information and respond.

Therefore, the author’s department, which obtained the information, investigated overseas websites open to the public in order to correctly interpret the relevant laws, regulations, and standards, and gathered information on unclear points by utilizing research companies and consultants. We also requested cooperation with the investigation from overseas offices, retailers, and overseas industry groups. At the same time, because the relevant parties in-house were diverse, we persistently persuaded related departments through activities such as gathering them for various regular meetings. As a result, we clarified the promoting department and the people in charge who can provide ongoing consultation and response for the Chinese CS Law and European CRA.

A similar system is also necessary for other cyber-related laws, regulations, and standards. Particularly for AI and similar fields, there are challenges that cannot be addressed with the same system because the elements of digital technology differ.

To address this challenge, it is necessary, for example, to obtain information on cyber-related laws, regulations, and standards from overseas bases and sales locations where products are introduced to the market. Steps must also be taken in-house, i.e., establishing centralized management relating to laws, regulations, and standards, and securing resources with clearly defined roles, to ensure that information reaches endpoint designers without being interrupted in the course of information communication.

In addition, it is necessary to establish an information-sharing system with industry-related groups active overseas such as the European JBCE and JETRO, as well as with government agencies. Based on the information obtained, the impact on business must be investigated, including issues such as the need for changes to products already launched in overseas markets, and costs associated with continued market entry (such as addressing vulnerabilities when they are discovered), and, depending on the situation, decisions must be made such as stopping market entry (Fig. 2).

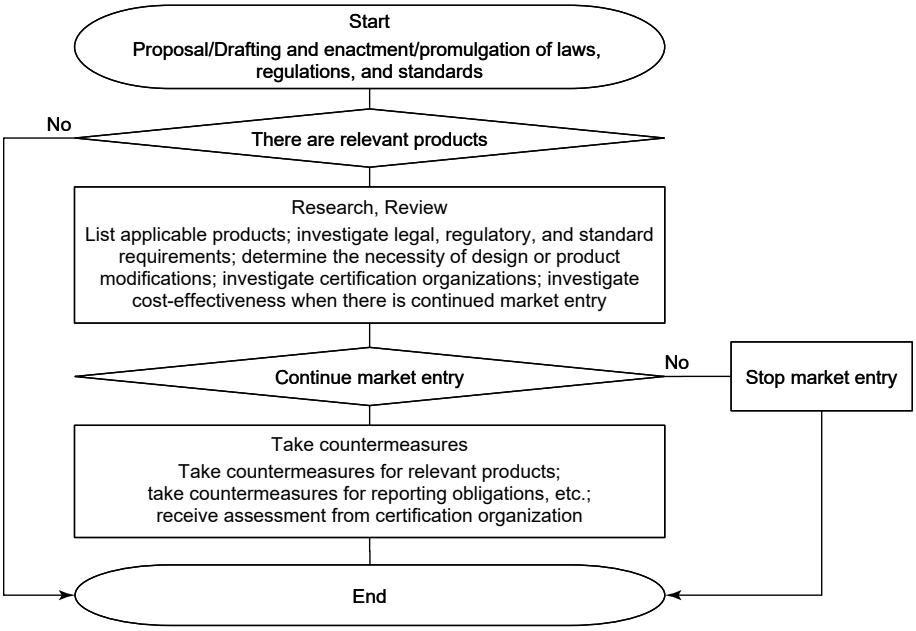


Fig. 2 Flow chart of compliance with laws, regulations, and standards

Overall, it is necessary to strengthen the existing physical-related legal, regulatory, and standards system to accommodate cyber-related laws, regulations, and standards and to develop and bolster human resources who are well-versed in cyber-related matters. This is a common challenge that needs to be solved by many companies.

5. Conclusion

As various transformations unfold on a global scale, recent geopolitical and economic issues have led to deglobalization, and the establishment and strengthening of cyber-related laws, regulations, standards, and requirements—such as the Chinese CS Law, the European CRA, and upcoming frameworks like AI regulation proposals, data laws, and digital product passports—are being considered.

For executives and managers of companies launching products in overseas markets, it is imperative to respond to such changes by proactively assigning appropriate personnel, strengthening human resource development, and establishing an organizational structure.

By promptly and seriously addressing cyber-related laws, regulations, and standards in various countries and regions, companies can adapt both as individual people and as organizations to diverse transformations of manufacturing, business models, and society, helping to raise the level of their corporate competitiveness. It is hoped this paper will help with that effort.

References

(1) Mitsubishi Electric PSIRT
https://www.MitsubishiElectric.co.jp/psirt/
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New Product Addition to "GS Series" and Chinese Input Function

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**Nagoya Works*

Abstract

The GS Series is a low-cost lineup for overseas markets that was launched in 2013 as part of Mitsubishi Electric's display business, and its functions have been continuously extended. We have developed the following with the aim of further improving added value in the Chinese market.

(1) Development of large-screen model GS2512-WXTBD

(2) Equipping with a Chinese input (pinyin conversion) function

Our aim is to expand our share of the Chinese market through development of these models and functions.

1. Introduction

Mitsubishi Electric has been continuously enhancing the functions of the GS Series, a low-price lineup aimed at the Chinese market, since its launch in 2013. However, the market demands models that offer higher functionality and larger screens while maintaining low prices, and the architecture of the current GS21-N model makes it difficult to meet these market needs.

Thus we introduced the GS25 model with a 12.1-inch wide screen to the market in January 2023 to meet these market needs. Figure 1 shows the lineup of Mitsubishi Electric displays for the Chinese market.

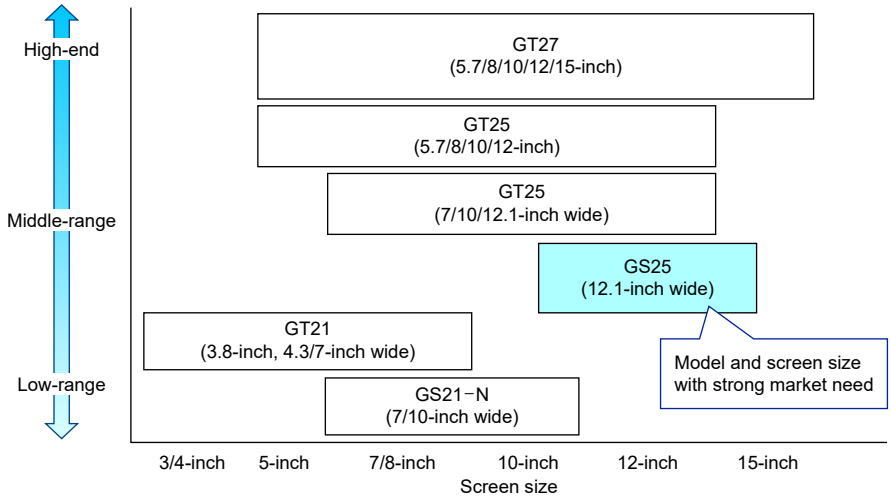

Fig. 1 Lineup of Mitsubishi Electric displays for the Chinese market

This paper describes product features, and the Chinese input (pinyin conversion) function using the Graphic Operation Terminal (GOT) for which there is a strong market need.

2. Purpose of Development

At Mitsubishi Electric, we are expanding our lineup and enhancing functionality by introducing products to the market that range from high-end models such as the GT27 to low-range models such as the GS series, in accordance with customer needs. Within this range, there has been increasing demand in recent years for low-priced models with large screen sizes such as 12-inch wide displays, but neither our company nor local Chinese companies currently have such models in their lineups.

By developing the GS25 model with a 12.1-inch wide screen, a low-priced yet large-screen model for which market needs are high, we aimed to expand the lineup of Mitsubishi Electric displays in the Chinese

market and enhance their added value. Also, by incorporating a Chinese input (pinyin conversion) function, which is in particularly high demand in the Chinese market, and the GOT Mobile function, which enables remote equipment maintenance, we aim to achieve synergistic effects with the addition of new models. This model achieves parts sharing and reduces development person-hours by basing its design on the architecture of the GT25 wide model, which has numerous built-in interfaces and functions.

In addition, we reduced manufacturing costs by manufacturing at our group company Mitsubishi Electric Automation Manufacturing (Changshu) Co., Ltd. (MEAMC) located in China, to develop a new model with high cost competitiveness.

3. Features

3.1 Product specifications

Hardware specifications for this model are shown in Table 1. The product is based on the GT25 wide model, thereby enabling connections and functions for diverse devices through numerous interface options.

Table 1 Hardware specifications

Item		GS25 model	GS21-N model (Existing model)
Screen size		12.1-inch wide	7/10-inch wide
Resolution		WXGA (1280×800 dots)	WVGA (800×480 dots)
Storage memory (ROM)		32MB	15MB
Operation memory (RAM)		128MB	-
Interfaces	RS-232	1ch	1ch
	RS-422/485	1ch	1ch
	Ethernet*1	2ch	1ch
	USB (host)	1ch (back side)	-
	USB (device)	1ch (front side)	1ch (back side)
	Sound output interface	1ch	-

*1 Ethernet is a registered trademark of the Fuji Film Business Innovation Corporation.
WXGA: Wide eXtended Graphics Array, WVGA: Wide Video Graphics Array

3.2 Equipped with 12.1-inch WXGA liquid crystal

This model is equipped with a 12.1-inch WXGA liquid crystal module, which is a large screen with high resolution. Compared to the existing GS21-N model (10-inch), it achieves approximately 1.4 times the screen size and about 2.7 times the resolution, enabling display of more information on a single screen (Fig. 2).

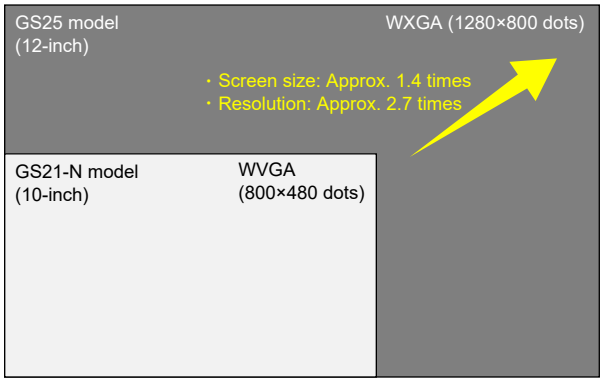

Fig. 2 Illustrative comparison of screen size and resolution

3.3 Chinese input (pinyin conversion) function

The Chinese input (pinyin conversion) function converts pinyin characters to the corresponding Chinese characters when pinyin is input, and this enables workers to input product names and other information in the GOT screen in Chinese (Fig. 3).

Fig. 3 Illustration of use of Chinese input function

In addition to displaying conversion candidates on the pinyin input screen, this function implements a “option selection window” function that displays a list of multiple conversion candidates in a separate window. The word to be converted can be easily selected by using the option selection window (Fig. 4).

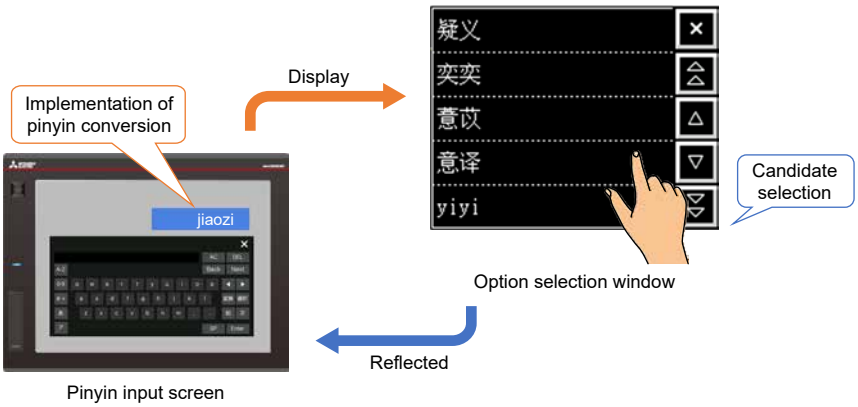

Fig. 4 Illustration of use of option selection window

3.3.1 Development background of the Chinese input (pinyin conversion) function

Previously, to input Chinese with GOT, an operation screen for entering Chinese characters was created on a computer and this was transferred to the GOT (writing of the operation screen to the GOT). Thus only preset Chinese characters could be input. Therefore, whenever users wanted to input new Chinese characters, they had to modify and transfer the operation screen, which was burdensome for users. Development of this Chinese input (pinyin conversion) function eliminates the need for operation screen modification and transfer, and greatly lessens the burden on the user (Fig. 5).

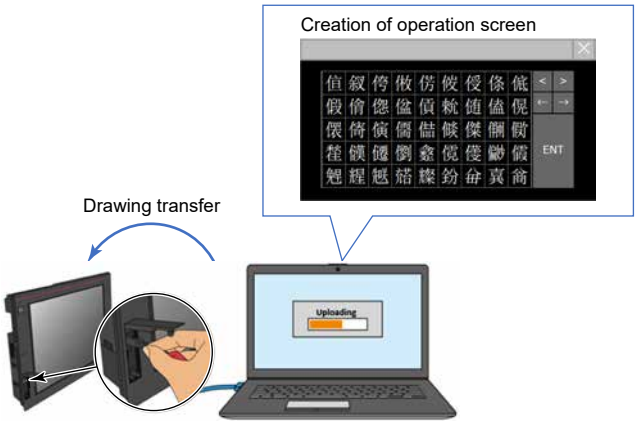

Fig. 5 Previous technique

3.3.2 Composition of software for Chinese input (pinyin conversion) function

The Chinese input (pinyin conversion) function has a character conversion processing part that converts the entered pinyin characters into Chinese characters, and a dictionary data part that contains conversion candidates for entered pinyin characters. In the interface of the character conversion processing part, character code conversion processing is performed for conversion to and reverse-conversion from character codes suitable for dictionary data. In the conversion processing part, processing is performed to search for conversion candidates from the entered pinyin characters using dictionary data (Fig. 6).

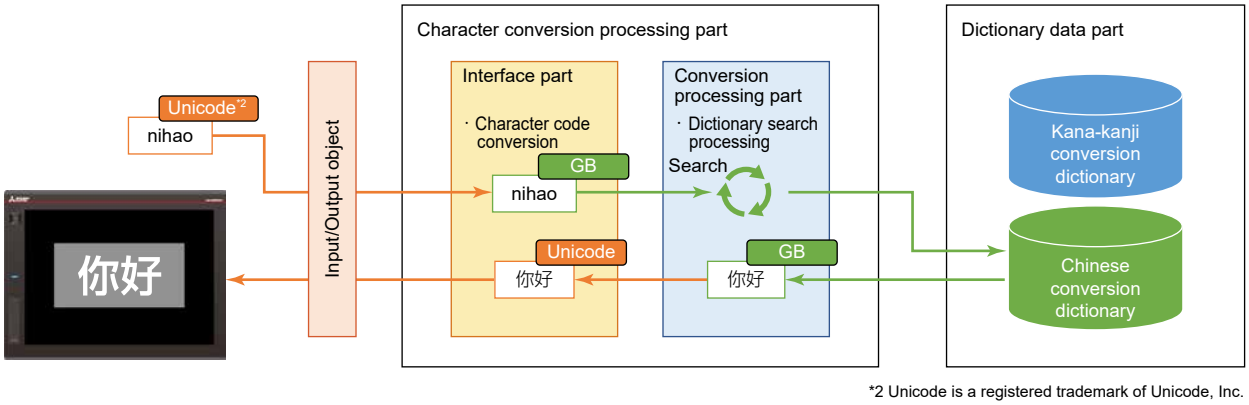

Fig. 6 Illustration of software composition

One feature of the character conversion processing part is that it allows development of various character conversion functions by replacing dictionary data. For the GOT, the conventional “kana-kanji conversion function” (a function that converts kana input to kanji) was designed during development with the expectation of use with other languages, and this design allowed us to carry out the development this time with small workload.

3.3.3 Realization of the same function with different models

For the Chinese input (pinyin conversion) function, it was necessary to realize the same function in different models, such as middle-range and low-range models whose architectures are different. Therefore, by designing their interfaces to match the architectures of individual models, we were able to absorb the differences between models, and provide the same functionality (Fig. 7).

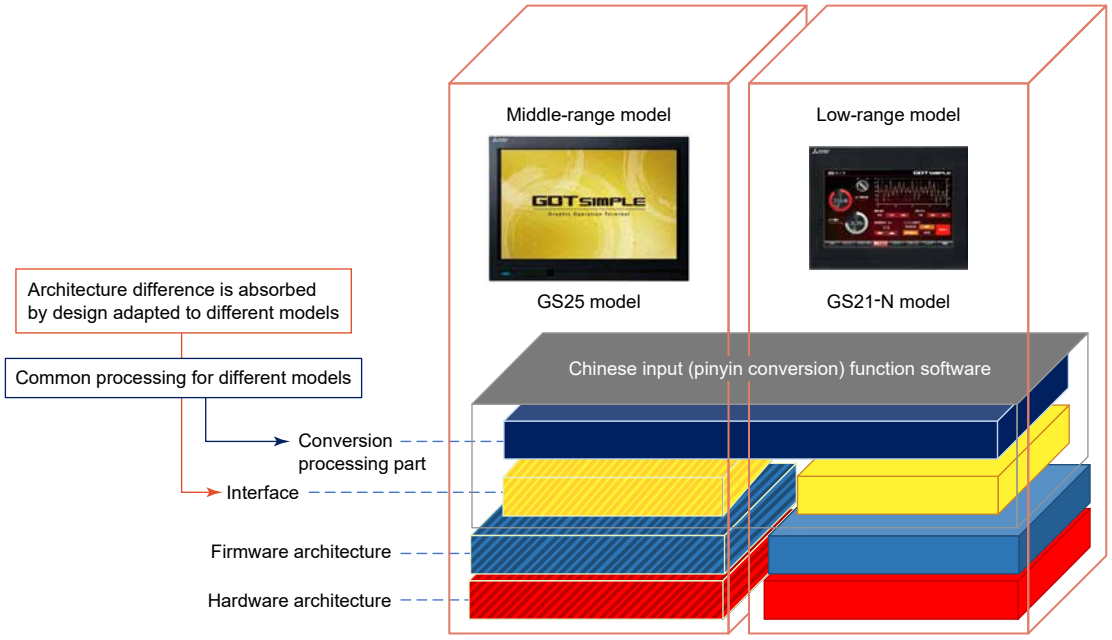

Fig. 7 Architecture differences between models

3.4 Two Ethernet ports as standard equipment

Equipped with two Ethernet ports as standard, it is possible to physically isolate the information network of facilities such as offices from the control network at production sites, enabling construction of secure networks (Fig. 8).

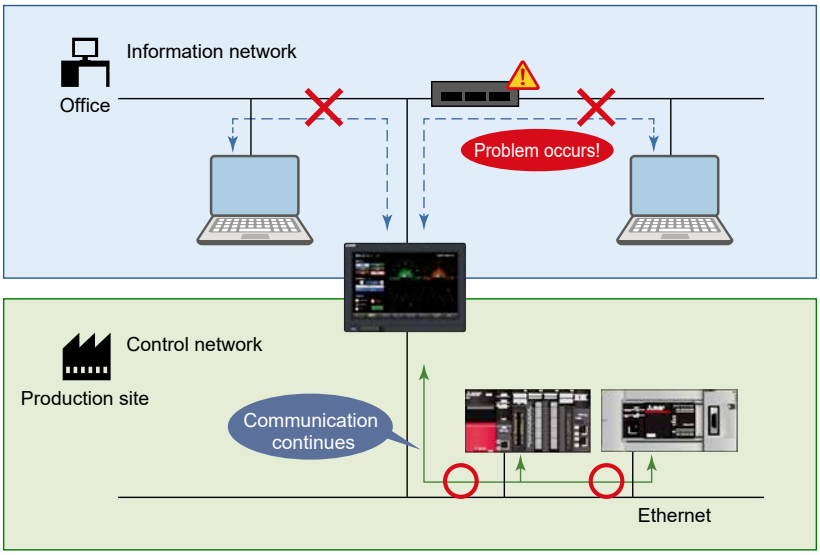

Fig. 8 Example of network construction

3.5 Equipped with sound output interface

Equipping the system with a sound output interface compatible with 3.5mm stereo mini plug realized the construction of an easy sound notification system by connecting general-purpose sound output devices. With the sound output function, notification of event content can be provided not only through display on the screen but also through sound, allowing necessary information to be more reliably communicated to workers (Fig. 9).

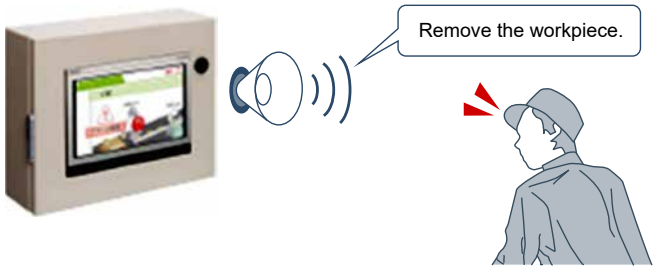

Fig. 9 Illustration of using sound output function

3.6 GOT Mobile function

The GOT Mobile function is a remote operation solution that enables monitoring and control of remote equipment by accessing the GOT using a web browser from various terminal devices such as smartphones, tablets, and computers. By using this function, it is possible to check the operational status of a production site while in an office, and for maintenance workers to control equipment using mobile devices, making remote maintenance easier (Fig. 10).

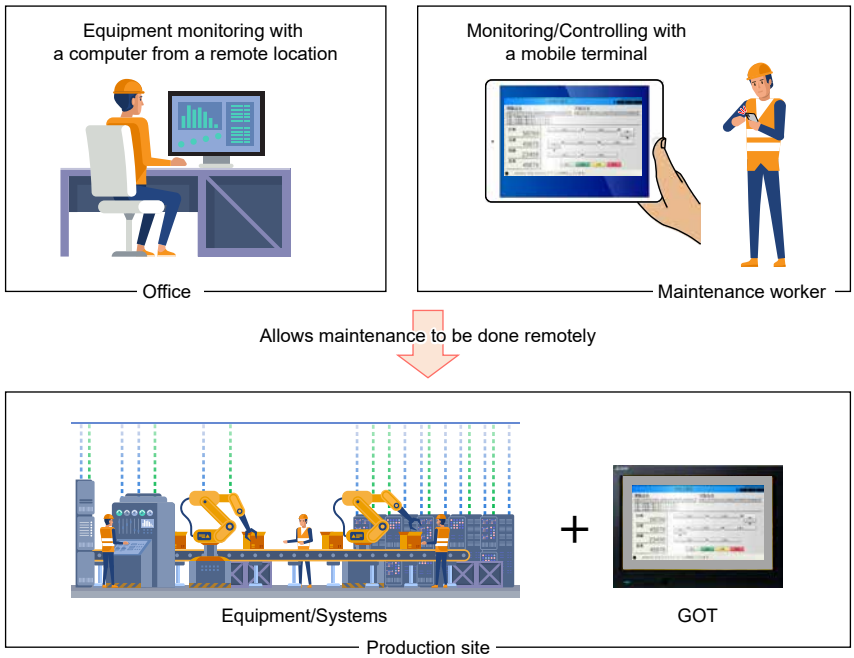

Fig. 10 Illustration of GOT Mobile function

With this function, five terminals can access a single GOT simultaneously, enabling multiple people to carry out operation from remote work locations such as worksites or offices. When multiple people are operating systems simultaneously, accident prevention measures are implemented by exclusive control of operation privileges to prevent simultaneous overwriting of the same parameters.

4. Conclusion

This paper has discussed the GS2512-WXTBD, which has a Chinese input (pinyin conversion) function in high demand in the Chinese market, while also featuring a large screen in a lower price.

Going forward, we will utilize the renewed architecture to continue meeting other market needs and strive to enhance the added value of Mitsubishi Electric displays.

Mitsubishi Electric's SCADA Software "GENESIS64"

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Abstract

Amid the promotion in recent years of Digital Transformation (DX) in the manufacturing industry, Supervisory Control And Data Acquisition (SCADA) software, which can centrally collect, store, and utilize data, has become increasingly prominent.

Mitsubishi Electric has made Mitsubishi Electric Iconics Digital Solutions, Inc. (MEIDS), the company developing the SCADA system "GENESIS64," a wholly-owned subsidiary and has been strengthening the product through joint development. GENESIS64 features high connectivity with external systems and devices, and offers rich data visualization methods and multifaceted analysis functions. Added value for the user has also been improved by enhancing compatibility with our FA-related products.

Use of GENESIS64 enables utilization of comprehensive data, and contributes to improved productivity and quality in the manufacturing industry.

1. Introduction

As DX rapidly advances in various industries, it is also being actively promoted in the manufacturing industry, with the aim of improving productivity and quality. Collection and utilization of data, which are the foundation of DX, have been emphasized as important themes in DX promotion activities. Under these conditions, SCADA systems, which feature the ability to efficiently collect and store massive amounts of data across the entire manufacturing process, and then effectively visualize and analyze it, are becoming increasingly widespread all over the world.

GENESIS64 is a SCADA software product that has been strengthened through joint development with MEIDS which became our wholly-owned subsidiary in 2019 (Fig. 1). This paper describes the features of GENESIS64.

Fig. 1 GENESIS64

2. Features of GENESIS64

2.1 Rich data visualization methods

GENESIS64 is equipped with various functions enabling effective visualization of data collected from monitored targets at facilities such as manufacturing sites, according to the desired purpose (Fig. 2).

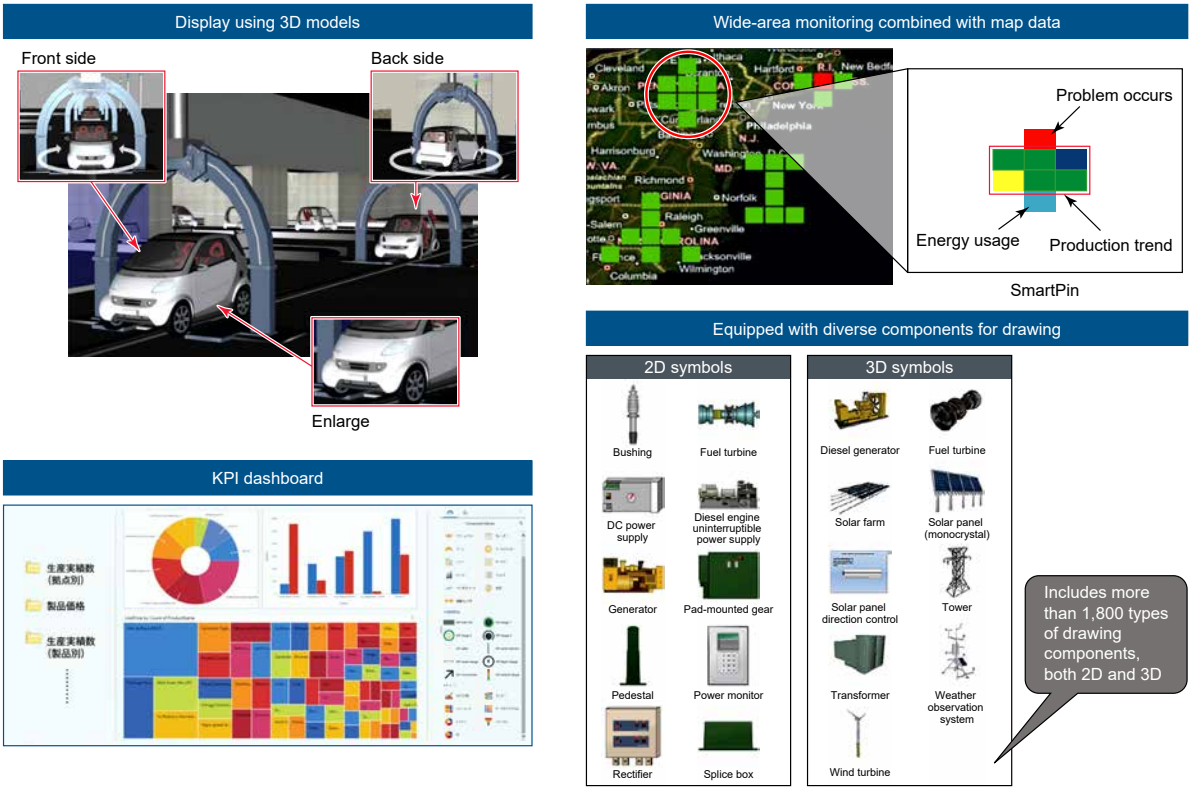

Fig. 2 Example of visualization using GENESIS64

This system naturally displays ordinary real-time data, but it also provides various visualization methods suited to applications, such as building models close to real environments using 3D functions, wide-area monitoring of multiple sites combined with map data, and displaying statistical information on the Key Performance Indicator (KPI) dashboard screen. An extensive range of templates are provided to create these screens, and screens with excellent design values can be built without creating components from scratch. Also, remote monitoring from various browsers and mobile devices is possible by putting screens on the web.

2.2 Utilization of data

GENESIS64 can collect and store massive amounts of data at a high speed of 100,000 items per second. It supports redundancy and distributed configurations for users who cannot afford data loss due to server failures or other problems, to enable construction of highly reliable monitoring systems. Also, collected data is not only stored as is, but can also be flexibly processed according to its intended application. The system also provides numerous functions for data analysis, contributing to on-site improvement from various perspectives and management decision-making (Fig. 3).

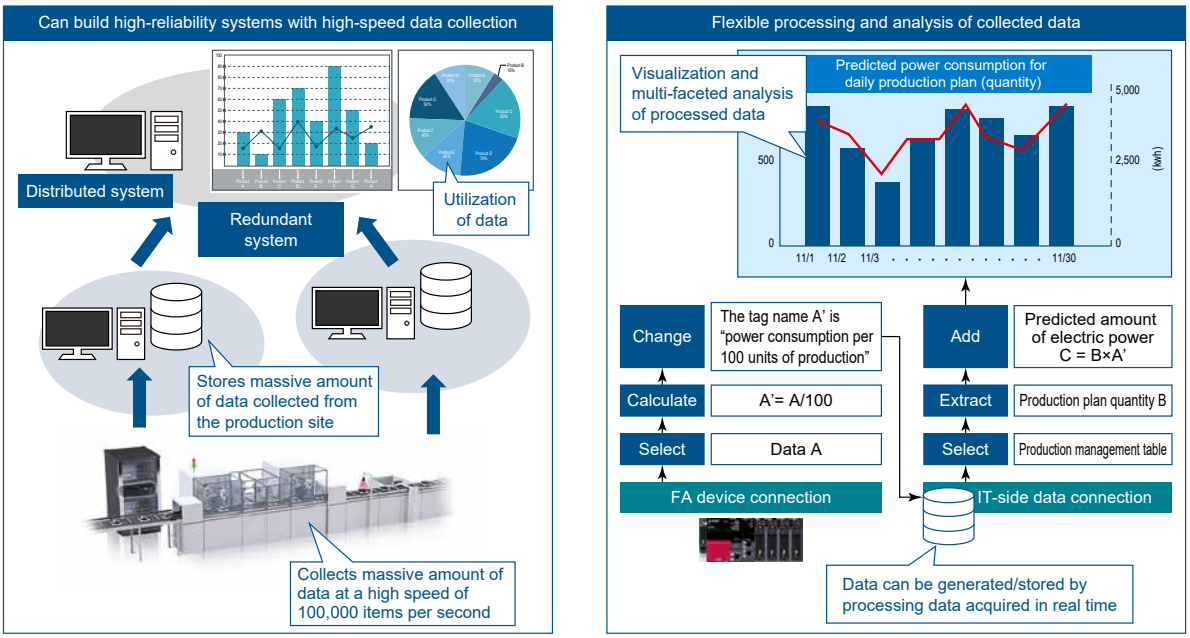

Fig. 3 Utilization of data with GENESIS64

2.3 Open connectivity

GENESIS64 has outstanding connectivity with various systems and devices, enabling flexible system construction (Fig. 4).

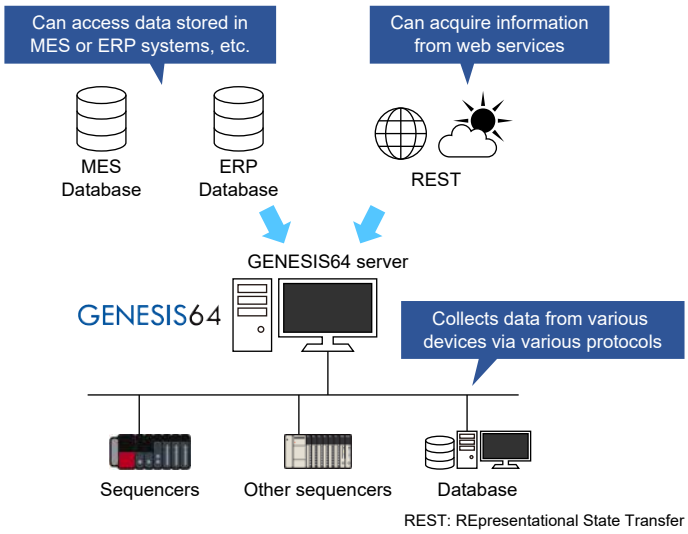

Fig. 4 GENESIS64 connectivity

(1) Support for industry standard protocols

The system supports industry standard protocols such as OPC*1, BACnet*2, and MODBUS*3, enabling connection with devices across a wide range of fields.

(2) Connectivity with host systems

Optimization across the entire manufacturing process is achieved by connecting with IT systems such as Manufacturing Execution Systems (MES) and Enterprise Resource Planning (ERP) systems, and performing integration and management with data from on-site Operational Technology (OT) systems.

*1 OPC is a registered trademark of the OPC Foundation.
*2 BACnet is a registered trademark of ASHRAE.
*3 MODBUS is a registered trademark of Schneider Electric USA, Inc.

(3) Interconnection with external web services

The system can connect with external web services through a REST Application Programming Interface (API) to display the acquired data on monitoring screens.

2.4 High compatibility with Mitsubishi Electric FA devices

GENESIS64 strengthens interoperability with our FA devices and related products to help improve added value for our customers (Fig. 5).

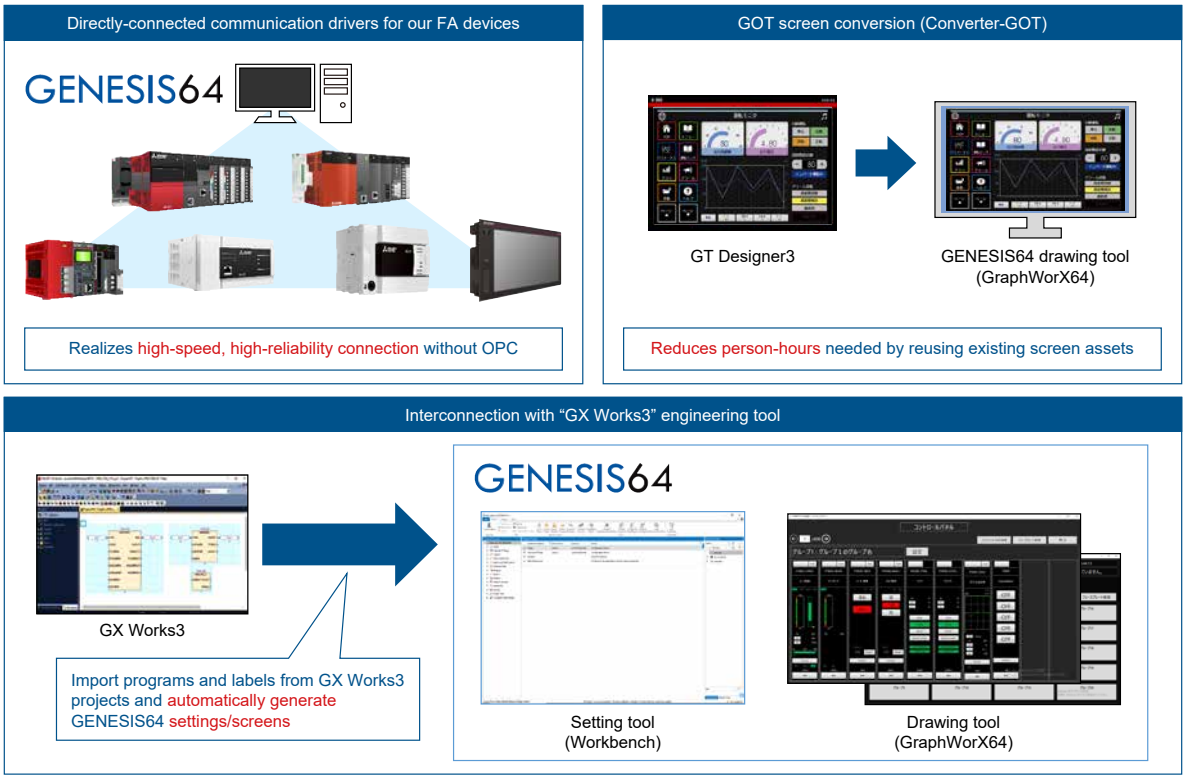

Fig. 5 Compatibility between GENESIS64 and our FA devices

(1) Directly-connected communication drivers for our FA devices

The system is equipped with a dedicated driver (Mitsubishi Electric FA Connector) for connecting with our FA devices, and this enables high-speed, high-reliability data collection without introducing an OPC server. Setting has also been simplified, and connection can be done by automatically detecting devices installed on the network.

(2) GOT screen conversion function (Converter-GOT)

A function is provided for converting screen data created for the Graphic Operation Terminal (GOT) of our Human Machine Interface (HMI) devices for use with GENESIS64. By utilizing screen assets designed for GOT, it is possible to reduce engineering person-hours required for system expansion.

(3) Interoperation with GX Works3

A function is provided that reads instrumentation programs created with our engineering tool "GX Works3" and automatically generates communication settings and monitoring screens for the monitored system. Also, label information defined in GX Works3 projects can be directly imported to automatically generate communication tags for GENESIS64.

3. Conclusion

This paper has described the features of GENESIS64 SCADA software. The trend of promoting DX in manufacturing is expected to accelerate, and as part of that, the importance of SCADA will continue to grow. Moving forward, we will continue to improve the added value of GENESIS64 by enhancing its functions and strengthening compatibility with our FA products.

MITSUBISHI ELECTRIC CORPORATION