RESEARCH AND DEVELOPMENT

Promoting Co-Creation and Open Innovation Aimed at Creating New Businesses

Supporting digital transformation for customers, the OKI Group promotes the development of new integrated technologies in its stronghold of contact regions between physical reality and digital spaces from the viewpoint of "connected society," "connected lifestyles," and "connected manufacturing" to advance further down the path of digital transformation.

From a "connected society" standpoint, we aim to establish "smart sensing" technologies that integrate our strengths in sensing technologies and networks in conjunction with our know-how in AI/data analysis. From a "connected lifestyles" standpoint, we aim to develop "humane mechatronics" technologies that integrate our strengths in mechatronics, human-machine interface (HMI) and dialogue-oriented artificial intelligence (AI) systems. From a "connected manufacturing" standpoint, we aim to establish "various kinds, various volume production" technologies that integrate our production technologies and augmented reality (AR) and virtual reality (VR) applications with our strength in data use.

1. "Smart Sensing" Technologies for a "Connected Society"

OKI has strengths in three necessary elements for the Internet of Things (IoT): sensing technologies, networks, and AI/data analysis. While developing more advanced forms of these technologies, we seek to realize a "connected society" by organically linking these elements together to collect and analyze in real time in-depth information from the field, which was not possible until recently.

Sensing

OKI has developed optical fiber sensing technology that detects distortions in optical fibers, their temperature, and the distribution of signal oscillations in real time from minute changes in optical signals detected with high precision. Optical fiber installations make it possible to detect fires across a wide area, monitor the condition of structures, and detect trespassing in real time. These technologies, along with the zero energy ultrasonic water-level gauge which monitors river water levels using solar power, will contribute to social infrastructure monitoring.

Networks

OKI developed the world's first 920MHz band wireless multi-hop network technology with low power consumption requirements that can be scaled up for large systems. This versatility allows various sensors and equipment to be connected to the network regardless of the environment. We expect combining this with 5G technology such as optical transmission and AI/data analysis technologies will lead to applications in the field of structure monitoring.

AI/Data Analysis

OKI is accumulating data from sensing technologies in fields such as traffic, disaster prevention and manufacturing. Through analysis of these massive data collections, we are working to develop technologies that extract in-depth information from the field.

2. "Humane Mechatronics" Technologies for "Connected Lifestyles"

OKI is working to develop new humane mechatronics technologies that integrate HMI and dialogue-oriented AI technologies with OKI-developed mechatronics for various terminals such as ATMs, printers, ticket vending machines and KIOSK terminals.

There are many OKI terminals connected to networks with interfaces that enable end users to operate them directly. Whereas hardware has often been designed for single functions such as cash deposits and withdrawals, printing, and dispensing train tickets, we are now pursuing work aimed at developing advanced terminals that combine multiple services in concert with the surrounding environment and user status while communicating with users. We aim to create communication terminals that provide services while staying close to users and talking to them so the terminals can sense what they want, rather than users turning to installed terminals for specific purposes.

3. "Connected Manufacturing" Technologies for "Various Kinds, Various Volume Production"

Our production facilities are used to manufacture not only OKI-branded products but also to manufacture the products of other companies on consignment in ways that meet our standards for reliability and quality. Our strengths are not just our mass production lines, but also the flexibility in responding to customer needs for low-volume runs that range from a few units to several million units.

By combining AR, VR and AI/data analysis technologies with such production technologies, we aim to realize "various kinds, various volume production" technologies that can respond in real time to an even wider variety of needs.

For example, we aim to achieve high efficiency in performing an ever changing series of tasks for small-lot consignments where we harness AR technologies to superimpose on sub-assemblies by displaying sub-assembly instructions for each task set. Moreover, levering VR technologies, we aim to be able to handle the maintenance tasks at the same level as proficient engineers, even by a beginner or an unexperienced person at the work site by having a task instruction remotely from such an experienced engineer.

Initiatives for AI Technology to Bridge between Physical Reality and Digital Spaces

The OKI Group boasts strengths in contact regions between physical reality and digital spaces. In these areas, our objective for the kind of AI we are working on is to make the interface between reality and digital more sophisticated.

In the field of image IoT, we are working on developing AI technology that has high environment resistance and excels in high-speed, lightweight recognition processing at edges where data is obtained from the real world. This kind of technology is applied in fields such as transport and logistics in which the OKI Group possesses ample data and know-how.

In order to make interaction with humans more sophisticated, we are also working on technologies like abnormal behavior recognition, emotion recognition, and dialogue-oriented AI technologies. By fusing these technologies with our mainstay mechatronics technology, we aim to make the point of contact between humans and mechatronics equipment more amiable and also deliver services that are flexible according to the circumstances of each person. In order to link real business practices, which demand accountability, with AI, where the processes from which answers are derived tend to exhibit a black-box nature, we are endeavoring

to elicit accountable and highly accurate results by combining theoretical man-made models with machine learning. This will make it easier for AI to be employed in businesses and operations that demand accountability.

In light of the speed at which AI technology is advancing, we will not necessarily restrict R&D to our in-house programs, but also aim to propel initiatives with a sense of urgency and include open innovation with universities and startup firms.

Comment from Engineers
We believe AI to be a key technology in solving societal issues such as labor shortages and workstyle improvements. For this reason, we engage in AI-related R&D on a daily basis. Developing AI that works in real world requires observation and understanding of the mechanisms of people's actions, devices, and society, which is certainly a field where the OKI Group's accumulated knowledge can be harnessed.

Fiber-optic Sensing Technology to Instantly Detect Abnormalities at Multiple Points, Including Production Line Temperature and Bridge Distortion

The OKI Group is developing fiber-optic sensing technology to enable real-time, multipoint distribution measurements of temperature and distortion at social infrastructure facilities like production lines and bridges.

Our proprietary technologies are applied to the core optical detection components to realize real-time, multipoint measurement technology that had been out of reach in the past. Our "fiber-optic sensors" evaluation kits that employ this technology can carry out wide-ranging distribution measurements

at spatial resolution of one meter. By instantly detecting abnormalities, this technology contributes to ensuring security and safety at social infrastructure facilities and customer assets.

The sensing data are centrally managed via local-area networks (LAN) and wide-area networks (WAN) on an IoT platform with the aim of developing monitoring systems that enable an even higher level of organic sensing. We also hope to contribute to solving issues in a broad range of fields by combining the aforementioned technology with high-level analysis technology such as AI.

Temperature distribution measurement for heat treatment processes or large spaces
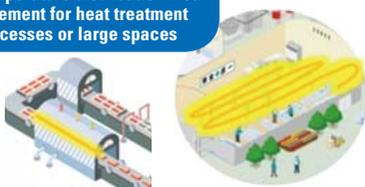
- Yields improvement and product traceability management realized by temperature distribution measurement inside manufacturing equipment
- Temperature management of large plants

Detection of abnormal temperatures, such as in tunnels or multi-purpose ducts
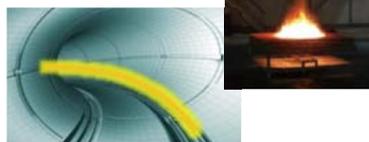
- Early fire prevention measures utilizing detection of location of fires or abnormal heat

Distortion measurement of infrastructure facilities
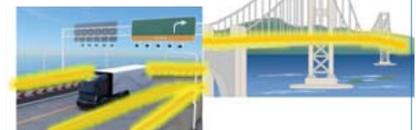
- Distortion measurement, inspection, and monitoring during bridge construction
- Monitoring of wire rope tension, etc.

Comment from Engineers
With the aim of realizing a sustainable society, we are shifting away from a society based on "throwaway" culture and towards a society that stresses the need for maintenance. We are working on developing a system that monitors the "health" of social infrastructure and customer assets by harnessing fiber-optic sensing technology to ascertain in real time the status of broad expanses running along optical fiber.