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 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 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 imaging and radio sensing technology we have developed over the years, 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 data analysis technologies will lead to applications in the field of structure monitoring.

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 and VR 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, leveraging VR technologies, we aim a situation, in which a beginner or even an unexperienced person at the location can handle maintenance tasks at the same level as a veteran engineer by having a veteran engineer remotely communicates maintenance task instructions.
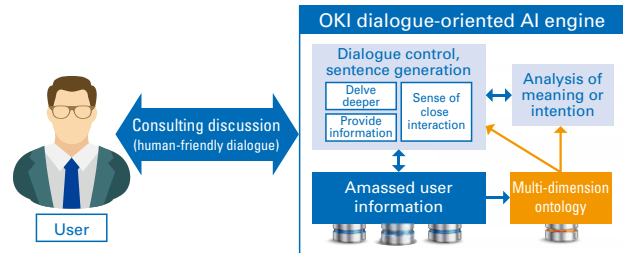
Dialogue-Oriented AI Technology Draws Out Hopes and Genuine Needs of Users

OKI has developed several dialogue-oriented AI technologies that integrate proprietary natural language processing technology and knowledge processing technology.

Today, it is testing several kinds of dialogue systems with an eye to commercial potential: one uses frequently asked questions (FAQ) to respond to user inquiries in a Q&A format; another keeps chatting with users in steps with their utterances; and another is a voice-operated instruction system that works on smartphones and computers. Apart from these, OKI is developing a dialogue-oriented AI system with embedded expert knowledge for consulting-type discussions. With unique ways of expressing knowledge using multi-dimensional ontology technology* (patent protected) and knowledge and discussion know-how like that of experts, this system can ask the proper probing questions, provide information, and interact with users in the same way as experts do, enabling us to construct human-friendly services and systems. Through this system, users are able to engage in dialogue with the system in a more natural manner.

*Multi-dimension ontology technology: Technology that adapts the knowledge it calls upon dynamically in the midst of a discussion in response to contextual information about users it has accumulated.

Comment from Engineers

The dialogue-oriented AI system draws on OKI's nearly 30 years of R&D in natural language processing technology and knowledge processing technology as well as its product development experience. We feel very pleased to be able to deliver such a system to our customers. In step with further advances in the dialogue-oriented AI system, we plan to focus on developing technologies that retrieve the knowledge it needs for dialogue from existing texts (manuals, other materials) and dialogue logs.
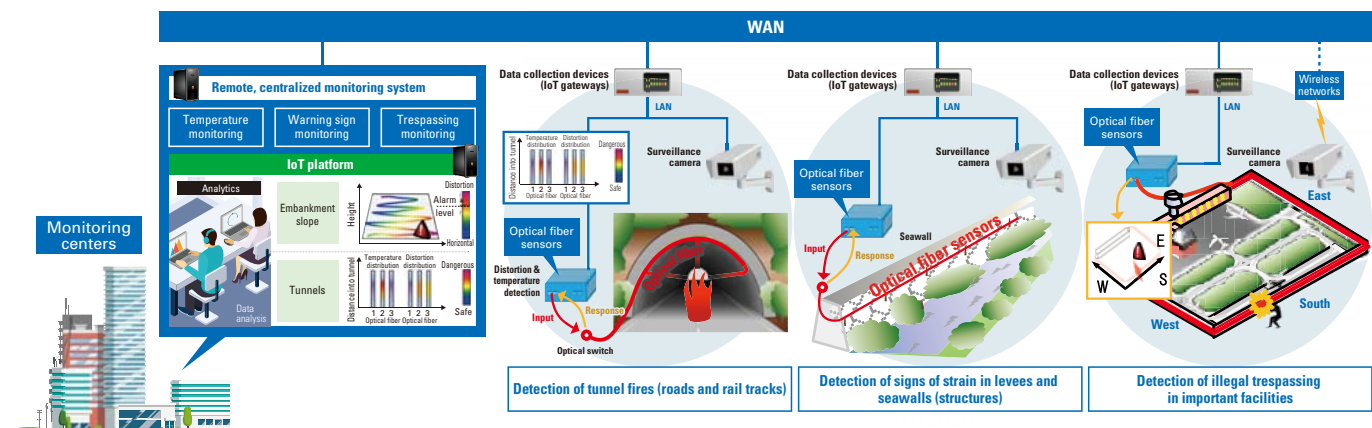
Optical Fiber Sensing Technology for Advanced Social Infrastructure Management and Facility Security

OKI has developed a wide array of optical fiber sensing technologies that it expects to apply to detecting illegal trespassing into important facilities and to real-time condition monitoring of large-scale structures with temperature-tracking and distortion-sensing technologies.

Toward sensing temperature and distortion, proprietary OKI formats are applied in the core light detection components. It is able to provide at a low cost advanced measurement technology that had been out of reach in the past such as real-time distribution measurements of dynamic strain in large-scale structures. Moreover, OKI succeeded this time in developing unique oscillation detection technology that can accurately detect irregular vibrations in optical fibers induced by interaction with trespassers. Combined with high-level analysis technology such as AI, it is expected to eliminate false alarms, which had been a concern with illegal trespassing detection applications, contributing to stronger security at important facilities such as airports and electric power plants.

OKI will centrally manage the sensing data collected from optical fiber sensors and other devices 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.

Detection of tunnel fires (roads and rail tracks)

Detection of signs of strain in levees and seawalls (structures)

Detection of illegal trespassing in important facilities

Comment from Engineers

One unique attribute of optical fiber sensing technology is it can ascertain in real time an overall view of the status of broad expanses that run along installed optical fiber without requiring many sensors. We are working to develop high-reliability sensing technology and data-mining technology that makes full use of the strength of optical fiber sensing technology to unerringly detect illegal trespassing into important facilities like airports and electric power plants and monitor conditions at aging bridges, tunnels and other infrastructure.