NEC Innovation Day

06

Real-world sensing

Evolution of Sensing Technologies for Realizing Precise Digital Twins

NEC's Direction of Real-world Sensing

Digital twins which enable various simulations are essential for the total optimization of social systems. Sensing technologies to reproduce the real-world in cyberspace are important.

Real-world sensing

Visualization using direct observation data

Sensor data (e.g. RFID tags)

Camera + Image analysis

Comprehensive (wide range, internal) sensing and meaning understanding

Extending the types of data that can be collected

×

Understanding meaning from collected data with AI

Value creation with precise digital twin

Digital twin of city

Required Sensing
- Structural conditions (roads and bridges)
- Traffic conditions (vehicle/human flow)

City that does not stop

Intelligent infrastructure maintenance

Digital twin of industry

Required Sensing
- Worker's activity
- Product condition and quality

Safe and efficient worksite

Automation
Work style innovation

Digital twin of human

Required Sensing
- Daily behavior
- Vital signs
- Emotions

World where no one gets sick

Daily inspection
Early detection

Optimize the whole society by connecting individual digital twins

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Core Technologies for Real-world Sensing

Technologies to deeply understand meaning with ①various sensors and ②AI analysis ③Technologies to reduce the cost of AI construction needed for deep understanding

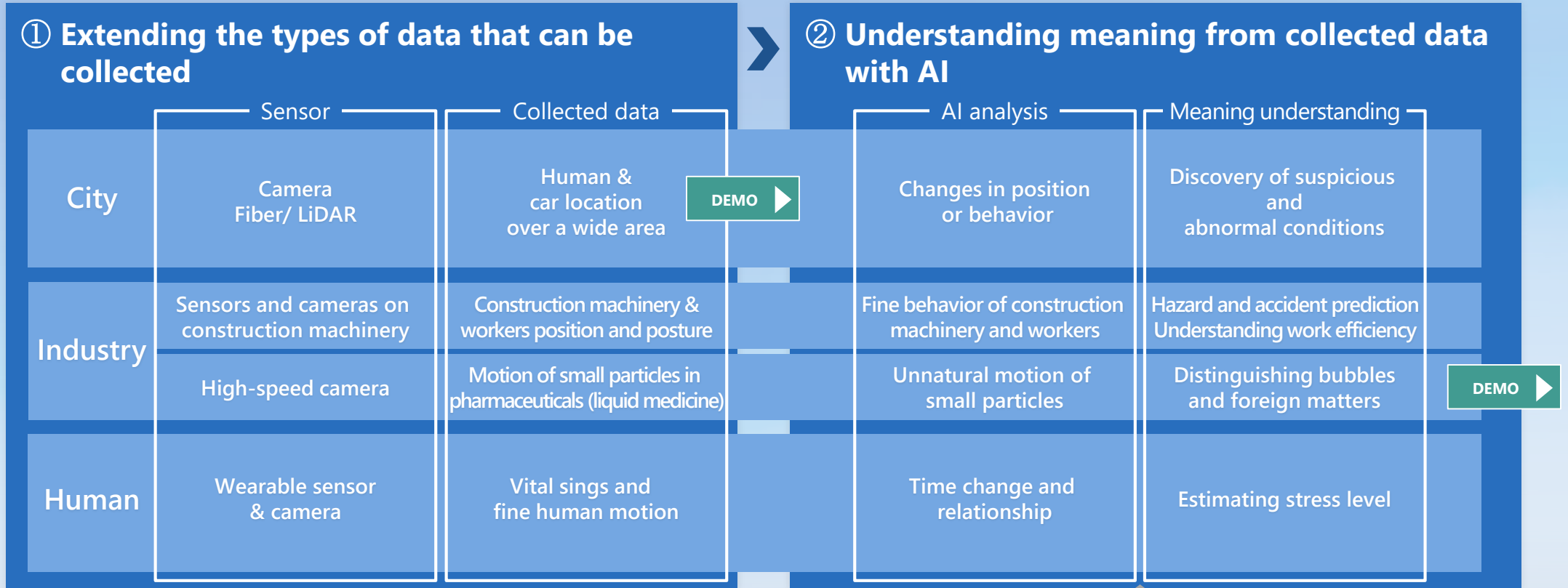**Real-world** ▷

① Extending the types of data that can be collected

▷

② Understanding meaning from collected data with AI

	Sensor	Collected data		AI analysis	Meaning understanding
City	Camera Fiber/ LiDAR	Human & car location over a wide area	**DEMO** ▶	Changes in position or behavior	Discovery of suspicious and abnormal conditions
Industry	Sensors and cameras on construction machinery	Construction machinery & workers position and posture		Fine behavior of construction machinery and workers	Hazard and accident prediction Understanding work efficiency
	High-speed camera	Motion of small particles in pharmaceuticals (liquid medicine)		Unnatural motion of small particles	Distinguishing bubbles and foreign matters **DEMO** ▶
Human	Wearable sensor & camera	Vital sings and fine human motion		Time change and relationship	Estimating stress level

③ Cost reduction of AI construction (training data collection, training methods, annotation)   **DEMO** ▶

Precise understanding of the position and condition of people and objects over a wide area with existing optical fiber for communications

Sense vibration distributions over a wide area (up to 380 km*, 10 times longer than the competitors') at once by making full use of advanced optical communication technology

*By two-way communication systems

Joint demonstration with Verizon and Central Nippon Expressway Company Limited

Real-time monitoring of wide-area anomalies through continuous monitoring of the entire line with no monitoring leakage
Smooth traffic control through immediate response

(Conventional)
Camera Surveillance Range

Accident/Failure

Sensing device

Intrusion

Existing optical fiber
for communications (100km)
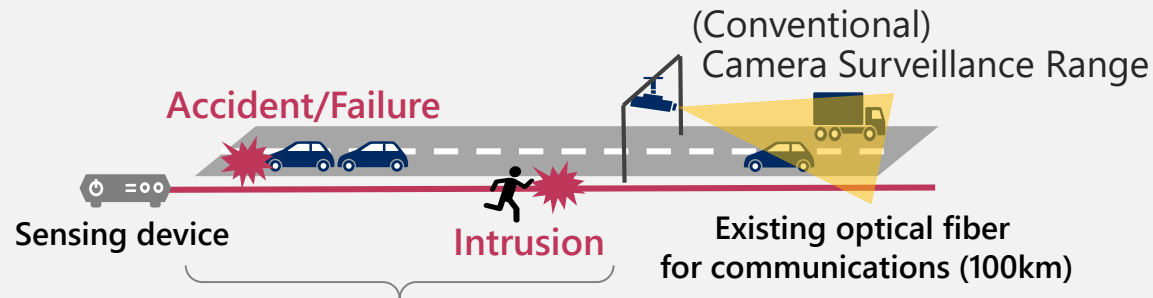
Unmonitored area (~several tens of km in rural areas) can be monitored using existing fiber-optic cables

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Outline of Dynamic Demonstration

Real-time detection of intrusioin and moving objects using outdoor optical fiber cable
Optical fiber cables installed along railway truck detect running train and intruders

Demonstration overview

JR Nambu Line

Musashi Kosugi

Mukagawara Station

Optical fiber cable (on-site)

Sensor
Camera

Camera View Angle
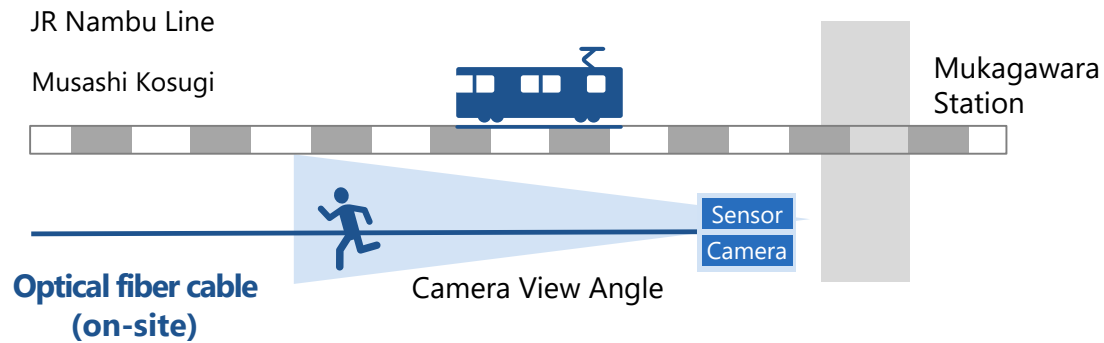
Intrusion detection

Detect people approaching the track with underground optical fibers

Train detection

Monitor railway traffic (presence and direction)

GUI

Real-time camera images

Intruder

Track

Underground burial Optical fiber cable
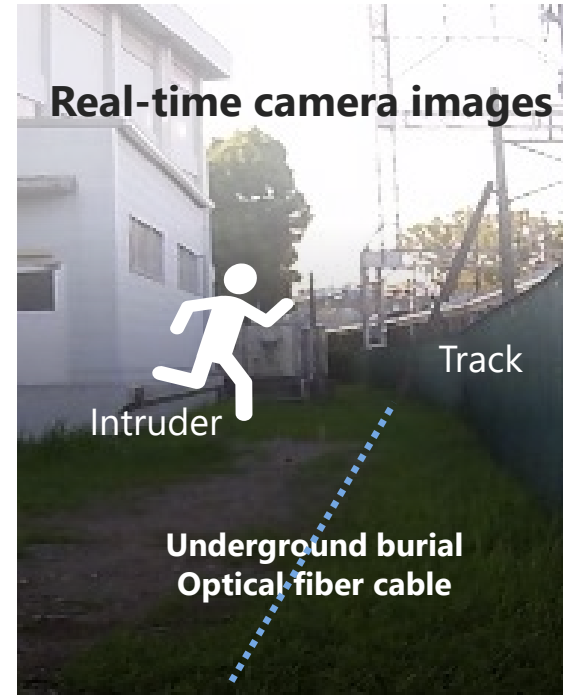
Railway Traffic monitoring (moving icon)

Musashi Kosugi ◄ ► Mukaigawara

Intrusion detection (Alarm with intrusion position)

Musashi Kosugi   Mukaigawara

Intruder alarm

Sensing data

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Real-world sensing
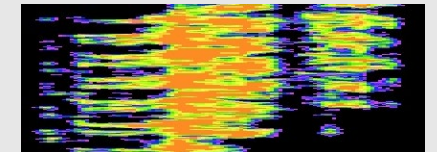
Detect foreign matters from their motion trajectory pattern in liquid pharmaceuticals

The AI classifies fine particles into foreign matters and bubbles from their motion trajectory pattern on high-speed camera videos. This technology enables a rapid increase in production for liquid products and realizes high inspection reliability.
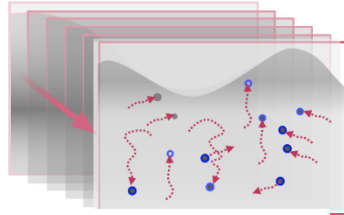
Imaging
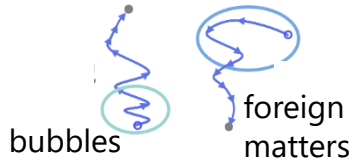Shake the bottle
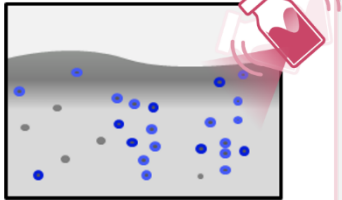
Floating bubbles and foreign matters

Tracking
Track all particles

Trajectories from over 100 fps video

Classification
Classify all particles into bubbles and foreign matters

bubbles   foreign matters

Characteristic motion

Bubble

Foreign matter

By daring to shake the bottle filled with liquid, the difference of motion between foreign particles and minute bubbles becomes clear and they can be classified correctly. It enables to reduce over-detection

        Supported by Ono Pharmaceutical Co., Ltd.   \Orchestrating a brighter world   **NEC**
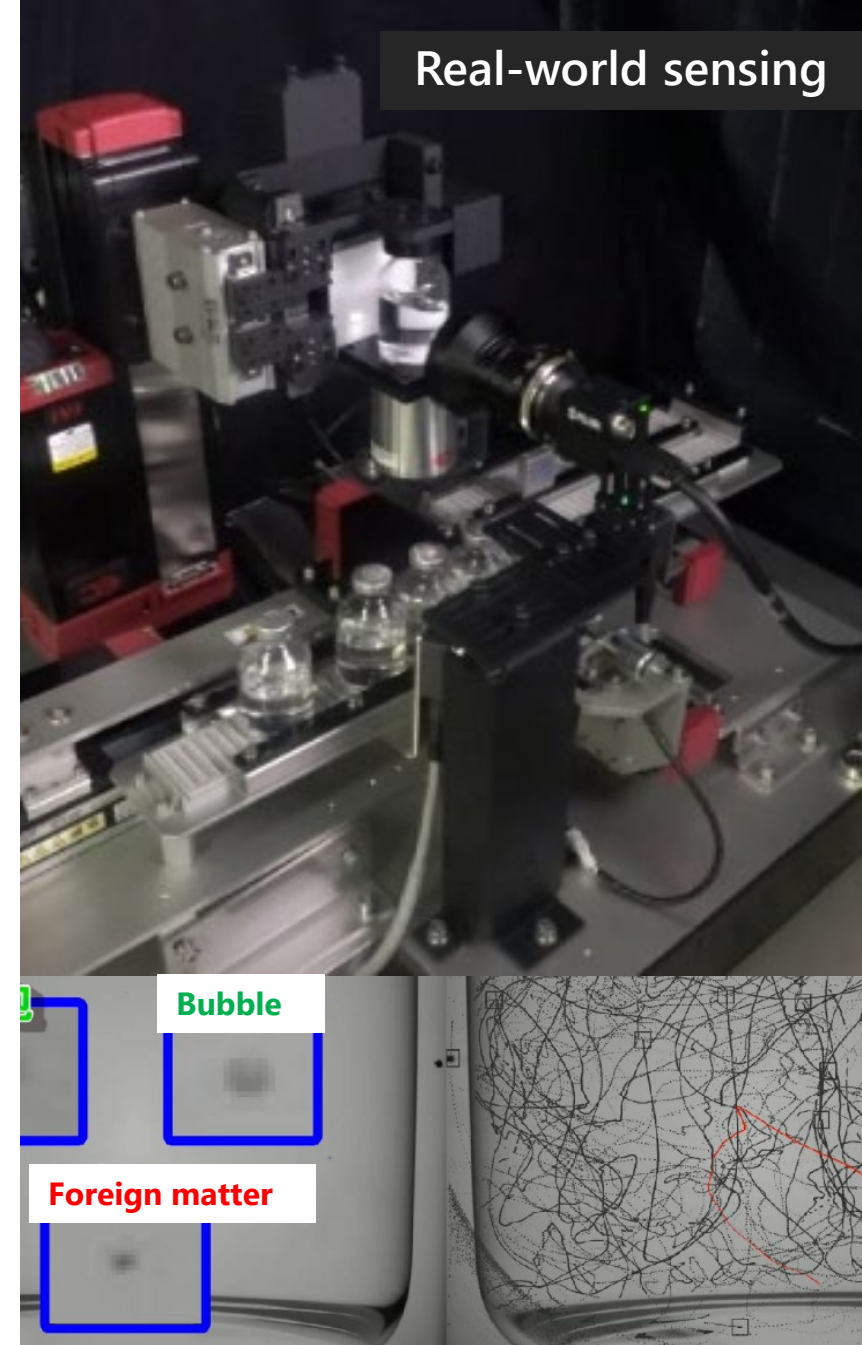
# Easy registration of new products in an image recognition just by turning it in front of a camera

Dramatically reduce human and time costs of new product registration work which is required for product management using image recognition.
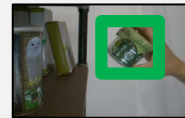
BEFORE

Manual editing work such as image cropping is needed for registration. It requires 30 minutes per product.

AFTER

Registration is completed in just 10 to 20 seconds just by holding and turning a new product in front of a camera.
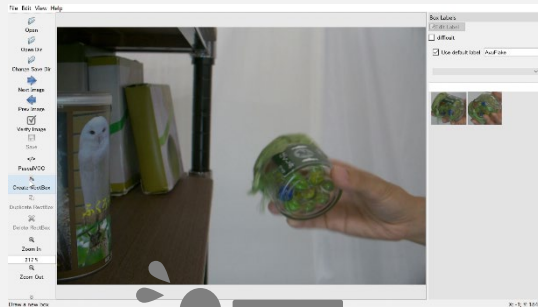
・No specialized shooting equipment required
・Automatic editing with AI technology

Cropping of product area

Removal of unnecessary images

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