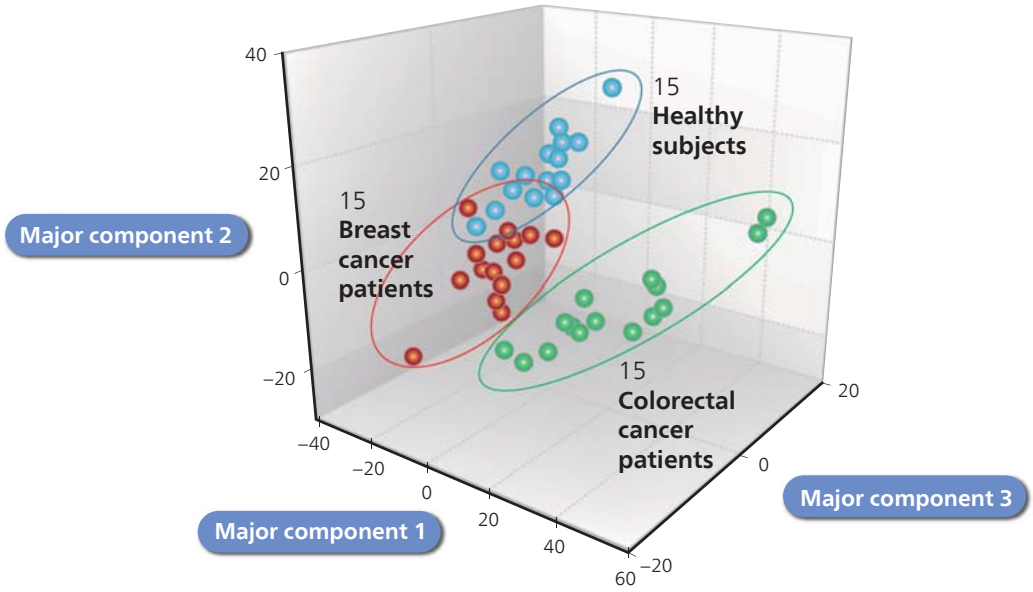
Exploratory Research



1 Results of identified healthy subjects, breast cancer patients, and colorectal cancer patients

1 Identification of Urine Samples of Healthy Subjects and Breast/Colorectal Cancer Patients through a Comprehensive Analysis of Urine Metabolite

With a view to establishing technologies that will enable anyone to easily take a cancer test, Hitachi is promoting a study on basic technologies for new cancer tests using urine samples.

Recently, Hitachi has successfully developed basic technologies that enable users to identify the urine samples of healthy subjects, breast cancer patients, and colorectal cancer patients through a comprehensive analysis of urine metabolite. More than 1,300 metabolisms, including sugar and lipids, were detected in urine samples, which were narrowed down to around 10 biomarker candidates that help identify the urine samples of cancer patients. The urine of cancer patients was distinguished from that of healthy subjects based on the difference in the amount of the specified biomarker ingredients found.

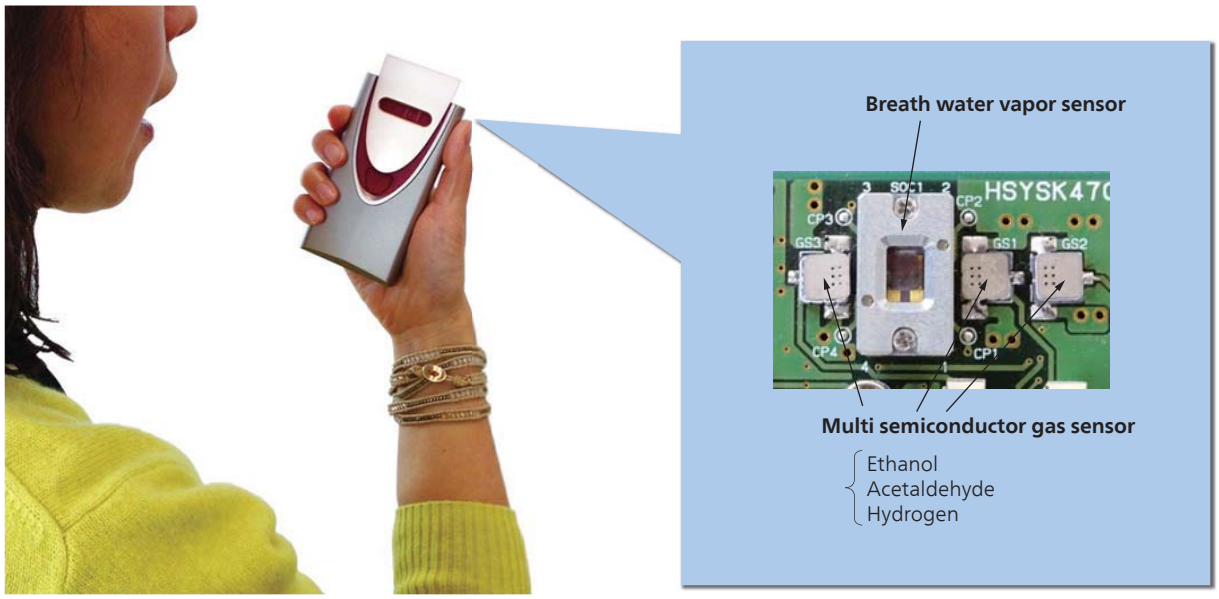
From here on, Hitachi will further investigate the relationship between cancers and candidate substances for biomarkers and undertake research to distinguish cancer types other than breast and colorectal cancer, as well as putting the technology to practical use.

These results were obtained in collaboration with Summit Pharmaceuticals International Corporation in the acceleration of transformative research for medical innovation by the Japan Agency for Medical Research and Development.

2 Portable Breath Alcohol Detector Linked to a Smart Key

Against a backdrop of enhanced global efforts to eliminate drunk driving accidents, Hitachi has successfully developed a prototype of a portable breath alcohol detector linked to a smart key in collaboration with Honda R&D Co., Ltd. This device is equipped with a function for recognizing exhaled breath without using a mouthpiece. The water vapor sensor for recognizing exhaled breath was transformed into a micro comb-shaped electrode geometry utilizing a semiconductor manufacturing process, which reduced the size to one-fiftieth and improved the sensitivity by an order of magnitude. Eventually, the detector could be made portable.

When a user breathes out onto the detector, the ethanol concentration can be measured accurately within about three seconds by the multi-semiconductor gas sensor. This device combines user friendliness, meaning that drivers can take a measurement anywhere before entering the car with a function that prevents abuse with gas other than exhaled breath. In addition, it links to a smart key by which the doors can be unlocked



2 Portable breath alcohol detector

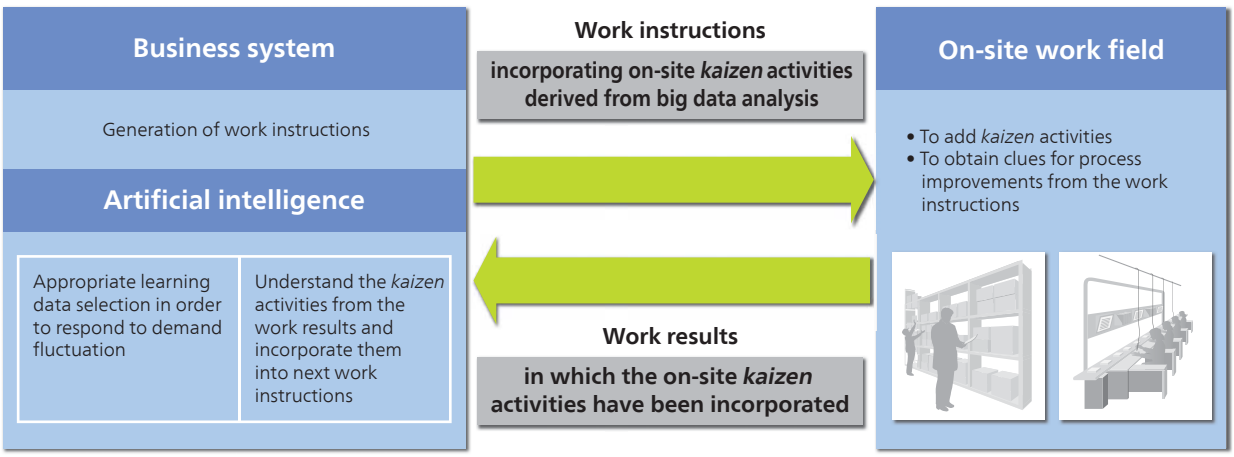
and the engine can be started, which means it serves as alcohol interlock and the engine cannot start when the driver is drunk.

Hitachi will conduct verification tests and contribute to the realization of a world without drunk driving.

3 Artificial Intelligence that Learns from Humans to Improve Business Processes

As customer demand has diversified and business processes have become more complex, on-site staff is required to respond promptly to demand fluctuation. Accordingly, Hitachi has developed artificial intelligence (AI) that provides appropriate work instructions based on an understanding of the demand fluctuation and on-site *kaizen* activities using big data, including work contents and performance accumulated daily in the business system. When integrating the AI into the warehouse management system and letting it collect the items, the working hours were reduced by 8% compared with the case when AI was not incorporated.

The AI analyzes the work contents and performance data and understands the creative solutions and improvements that on-site workers have devised. It then proposes a hypothesis, learns from the results, and incorporates them in the next work instructions. On the other hand, on-site workers obtain clues from the work instructions output by the AI and invent new creative measures and improvement activities, and make use of them for process improvement. By repeating this process on a daily basis, it is expected that the AI and human staff will cooperate with each other in a diverse range of fields while they achieve process improvement and respond to demand fluctuation.



3 Realize efficient operations through human and AI cooperation, coping with demand fluctuation

4 Wearable optical topography using SoC
(Hitachi High-Technologies Corporation)

4 New Optical Topography Using SoC

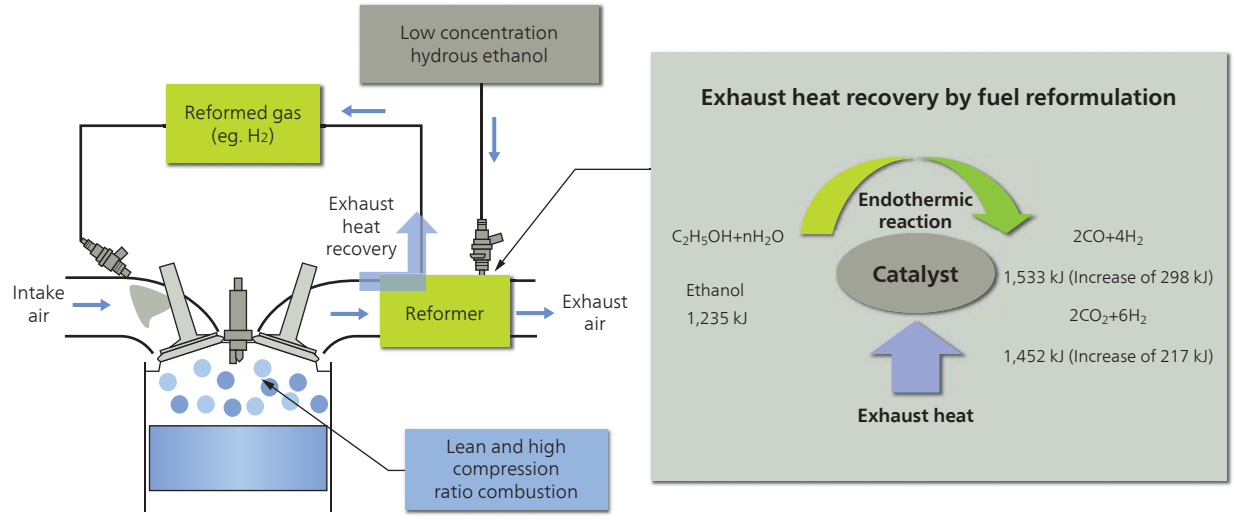
Optical topography, a non-invasive brain function measuring device, is widely utilized for medical use, such as examinations for brain surgery and psychiatry, and for research use, such as brain science and psychology. Since each brain function is located in a different position on the cerebral cortex, the requested specifications, including measurement position and measurement area, differ depending on the brain function to be measured. Traditionally, the design has been optimized according to the requested specifications for downsizing the device, so a significant change in design as well as time and cost were required to change the specifications.

Hitachi recently modularized the basic function of the light source and the detector by using a system on chip (SoC) to respond to the diversification of recent customer demand. SoC has a programmable analog digital circuit, so it is easy to change and expand the functions, and the micro processing unit (MPU) enables it to operate autonomously and provide command base control. This means that addition of an optical module makes it possible to respond to changes in equipment specifications in a simple and flexible manner, enabling Hitachi to rapidly provide products according to customer needs.

5 Regional Energy System Utilizing Low Concentration Hydrous Ethanol

With a view to constructing a low-cost, decentralized, and locally produced and consumed energy system that can reduce CO_2, Hitachi is developing a technology for the highly efficient use of low concentration hydrous bioethanol utilizing unused local resources. Low concentration ethanol is low in cost and safe due to the high water content. In addition, the system can be highly efficient through exhaust heat recovery in which hydrogen is generated from water and ethanol by using the exhaust heat of the engine.

Up until now, 45% efficiency has been achieved by lean combustion with an engine partly fueled by hydrogen in the Low Carbon Technology Research and Development Program led by the Ministry of the Environment (innovative high-efficiency engine fueled by low-concentration bio-ethanol). In validation for practical use, operational validation is conducted by using ethanol fuel produced from blackstrap molasses made in Miyakojima (Okinawa Prefecture). In this system, it enables the construction of not only distributed energy from bioethanol but also a stabilized electric grid with other renewable energy such as wind and photovoltaic power systems. Furthermore, the use of residual substances released in the bioethanol production process as manure and feed will invigorate industrial reconstruction including the island area. Hitachi is undertaking investigations toward establishing a circulating system.



5 Highly efficient engine system using hydrous ethanol