The Control Experience: “Light as Air with No Constraints”

The hand control in the Surgeon Cockpit is a vital component, enabling the surgeon to manipulate the system at will. However, this also became a challenge, as Doi recalls: “Surgeons requested that the hand control ‘give the tactile sensation of being as light as air.’ It was a challenge, as at first, we didn’t know how to realize such a request from a mechanical perspective.”

Key to resolving this issue was the gear reduction ratio. Because the hand control transmits a sense of “heaviness” when friction between the motor and the reduction gear increases, the developers lowered the gear reduction ratio to reduce the friction.

In addition, to better assist the surgeon’s operations, they improved the sensory aspect of the hand control by making mechanical modifications and upgrading the software.

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To ensure its operational safety, the robotic system is equipped with multiple monitoring systems, including a function which keeps the system deactivated unless the sensor of the 3D viewer detects the surgeon’s gaze in the viewer. Yamamori continues, “If the arms interfere with each other, an alarm is set off, but even if they were to collide, or an arm reaches the limit of its operating range, the system is designed in such a way that the surgeon can continue with the procedure.

Next Step: Improving Navigation

Regarding the future evolution of surgical robots, Yamaguchi of the ICCRC predicts that three navigational features will be subject to critical improvements: “One will be to enhance the level of procedural precision using accurately-visualized images of the affected area, obtained by injecting fluorescent dye into the surgical field. Another will be to accumulate and analyze data from robotic surgeries performed by expert surgeons, so that their expertise can be leveraged as best-practice examples. Finally, the advancement of telesurgery using 5G and 6G (5th- and 6th-generation) communication systems is also vital.”

On the same topic, Tojo comments, “We still have many challenges to overcome, but focused on the common goal of ‘contributing to improving global health from the perspective of patients and medical professionals,’ we would like to keep improving the hinotori™ through an open platform, utilizing the collective input of expertise from the stakeholders. These enhancements include virtual pre-operation simulations incorporating CT-scan images; the automation of simple suturing; and the transferring of seasoned surgeons’ skills to those with less experience.”

The hinotori™ has already begun its flight toward the next stage of this medical revolution.

SUPPORTING LIFE WITH TECHNOLOGY

Kawasaki Develops Automated Polymerase Chain Reaction (PCR) Testing System to Ensure the Safety of Our Mobile Society

The world’s first automated PCR testing system utilizing robots was recently developed by Kawasaki for the COVID-19 pandemic. As it is designed to increase protection for healthcare workers and improve mobility — which should facilitate economic recovery — the Company is encouraging various entities to consider adopting the system.

A robot performing opening and dispensing of specimens. Using robots for the process, which poses a high risk of infection, contributes greatly to reducing the burden on healthcare professionals.

The entire system is housed in a 40-foot container (12 meters long, 2.5 meters wide), and its robot conducts the entire testing process: 1) Centrifugation of specimens, 2) Opening of specimen containers and dispensing specimens into separate containers, 3) Nucleic acid extraction, 4) Reagent preparation, and 5) PCR measurement.

Because it requires no human intervention, the system ensures the safety of healthcare professionals while achieving simplified operations. It is the world’s first container-housed mobile system utilizing robots that allows for automated mass processing of specimens.

With a conventional PCR testing system, the PCR measurement — performed after opening/dispensing of specimens and nucleic acid extraction — takes 210 minutes. Given the additional time and work needed for transporting specimens to a testing site, it has been a laborious undertaking. With Kawasaki’s system, it takes only 80 minutes to receive results following specimen collection. This shortened time is attributable to limiting the number of specimens in each testing unit to eight, compared to 96 in conventional PCR testing, which reduces the time needed to raise and lower the temperature evenly across the specimens.

Assuming that it operates 16 hours a day, the system is capable of testing about 2,500 specimens per day, and capacity can be increased by adding more units of the system.

For example, in an airport with a testing facility using our system, a traveler could be tested and receive his/her results in 80 minutes. If the test is negative, a physician could verify the result and issue a certificate for the traveler to present upon entering the country of destination. (This might require a prior agreement between Japan and the destination country.)

The development project for this system was already underway in March 2020. In August 2020, the project was upgraded to a cross-divisional one led by the Presidential Project Management Division, and in February 2021, the testing business using this system was launched. Project leader Hirotoshi Tsuji of the Project Division, says, “Recovery of international business travel is an urgent matter to which Japanese and other governments, as well as industries across the world, are paying close attention. By checking passengers’ status of infection immediately before they board, we are trying to ensure that everyone can board worry free, and enter their country of destination using a certificate of negative result.”

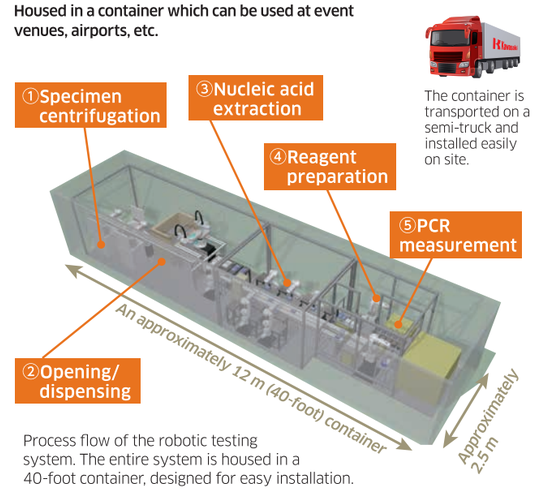
For the system, Kawasaki manufactures and systematizes the product, Sysmex acts as general agent for selling the PCR testing device and reagents, and Medicaroid serves as the Marketing Authorization Holder of the system. We anticipate that it will be used not only at airports but also at large sporting events.

Currently, Kawasaki is also developing a robotic system to collect nasal swab samples, and is working on obtaining approval for the system as medical equipment from the Ministry of Health, Labour and Welfare.

Robots can contribute significantly to creating a safe environment for travelers by reducing the risk of infection in any situation, thereby achieving new heights in technology’s contributions to society.

Kawasaki’s PCR Testing System

Housed in a container which can be used at event venues, airports, etc.



Process flow of the robotic testing system. The entire system is housed in a 40-foot container, designed for easy installation.