

# Supporting the Tokyo 2020 Games with People-friendly Robots

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Various new initiatives have been implemented at the Tokyo 2020 Games by The Tokyo Organising Committee of the Olympic and Paralympic Games, the national government, the Tokyo Metropolitan Government, and partner companies (Panasonic Corporation and Toyota Motor Corporation) to realize the vision of being “the most innovative Games in history”, bringing positive change to the world. Among the initiatives, Panasonic supported the Games by utilizing Power Assist Suits and robot vacuum cleaners. This article introduces the details of these initiatives.

**Keywords :** Tokyo 2020 Games, Robot project, Power assist suits, Robot vacuum cleaner

## 1. Introduction

The Tokyo 2020 Robot Project implemented various initiatives with the following objectives :

- To show that robots can be helpful in various situations during the Tokyo 2020 Olympic and Paralympic Games (hereafter referred to as “Tokyo 2020 Games”), which is attracting the attention of people around the world.
- To demonstrate to the world that a safe, secure, and sustainable operation of the Games is possible through using robots in the face of the COVID-19 pandemic.
- To promote the social implementation of these

robots, using the Games as an opportunity to pass them on as a legacy to the future.

This article introduces the details of the initiatives.

### 1.1 Power Assist Suit ATOUN MODEL Y (Figure 1)

Here 20 units of the ATOUN MODEL Y were used to reduce the workload of the operational staff during the Games. The ATOUN MODEL Y was used for transporting heavy food and beverages, waste materials, etc., and



Figure 1 ATOUN MODEL Y

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for loading the luggage of Games officials onto buses.

The specifications of ATOUN MODEL Y are as follows:

- ATOUN MODEL Y specifications :
  - Weight : 4.5 kg
  - Assist force : 10 kgf max.
  - Operating duration : approximately 4 hours (assuming that work is performed using ATOUN)
  - Ideal operator height : 150–190 cm
  - Features : The sensor detects the movement of the lower back of the person wearing the suit, and the motor reduces the burden on the lower back when holding a heavy load.

### 1.1.1 Application 1 : Para Powerlifting

After a successful track record of use in past national and international competitions, World Para Powerlifting (WPPO) has decided to adopt Power Assist Suits for the Tokyo 2020 Paralympic Games in 2019, and Panasonic has signed a partnership agreement with WPPO to become the official supplier.

The suits were used by spotter loaders (assistants who change weights) in all 20 weight classes of the powerlifting competition held at the Tokyo International Forum for five days from August 26 to 30, 2021. Figure 2



Figure 2 Assistance for Para Powerlifting Competitions

## Terminology

**LiDAR** Light Detection and Ranging. A sensor that emits pulsed laser light onto an object and measures the distance based on the time it takes for the reflected scattered light to return.

**SLAM** Simultaneous Localization and Mapping. A technology that simultaneously estimates self-location and maps the environment.

shows an example of its use by a spotter loader. The organising committee and Games officials operated the Power Assist Suits from battery recharging and replacement to installation, and spotter loaders highly rated the suits. The WPPO commented, “The model used in this competition was the best one, as we had been testing and devising it since 2017. Thanks to Panasonic, we had the most innovative competition”. He also stated that they were pleased with the results.

### 1.1.2 Application 2: The Olympic and Paralympic Village

The cleaning and food and beverage departments have used the Power Assist Suits since mid-July in the Olympic and Paralympic Village. The cleaning department used it to clean trash (Figure 3), and the food and beverage department used the Power Assist Suits, especially for carrying beverages (Figure 4).

### 1.1.3 Application 3: Haneda Airport and Narita Airport

At the airports, the Power Assist Suits were used for loading and unloading the luggage of athletes and related personnel. Figure 5 shows an example of the use of ATOUN MODEL Y. This model has been used by the airlines and was evaluated to be effective for up-and-down transportation, such as stacking and unloading.

## 1.2 ATOUN MODEL Y+kote

This variation helps with arm support (Figure 6). The motor unit attached to the upper frame of ATOUN MODEL Y winds the wire that connects to the wrist holder and pulls up the arm for support with power and



Figure 3 Application in the Olympic and Paralympic Village (Cleaning Section)

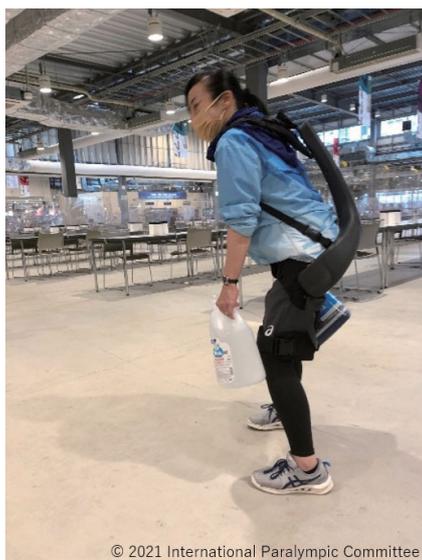


Figure 4 Application in the Olympic and Paralympic Village (Food and Beverage Section)

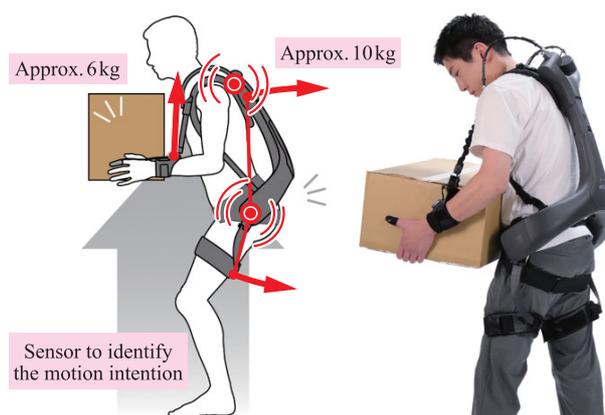


Figure 6 ATOUN MODEL Y+kote



Figure 5 Application at an Airport (Transportation Division)



Figure 7 Olympic Stadium Athletics (Shot Put)

speed.

The specifications of ATOUN MODEL Y + kote are as follows.

- ATOUN MODEL Y + kote Specifications :
  - Weight : 5.8 kg
  - Assist force : For arms-12 kgf ( max ) ; For lower back-10 kgf ( max )
  - Operating duration : approximately 2.5 hours ( assuming that work is performed using ATOUN )
  - Ideal operator height : 150-190 cm
  - Feature : The finger sensors detect motion, and the motor unit attached to the frame of the ATOUN MODEL Y will wind the wires to lift the arms,

thereby providing powerful and speedy support.

### 1.2.1 Application : Shot Put

The officials utilized the Power Assist Suits in the Olympic and Paralympic Athletics to retrieve the shot in the Shot Put. Figure 7 shows an example of the system being used. The officials gave positive feedback, "It was effective when standing up after bending over, and I was able to lift the men's shot with one hand easily". However, some commented that it was too hot to wear the Power Assist Suits for a long time, as it was worn for more than two hours under the scorching sun at the Tokyo 2020 Games.

### 1.3 Power Assist Suit ATOUN HIMICO

The wires connecting the motors to the knees are mounted on the waist housing to support and help users move their legs while walking (Figure 8).

The specifications of ATOUN HIMICO are as follows.

- ATOUN HIMICO Specifications :
  - Weight : 2.5 kg
  - Wire tension : Max. 10 kgf
  - Operating duration : Approximately 2 hours (de-

- pending on the walking situation.)
  - Ideal operator size : Height 155 cm-190 cm ; waist-max100 cm (measured with cloth)
  - Feature : ATOUN HIMICO supports the user's walk. Wires connecting motors on the waist to the knees support pulling and lifting the user's legs.



Figure 8 ATOUN HIMICO

### 1.3.1 Application 1 : National Stadium

With the cleaning department of the Olympic Stadium, the Power Assist Suits were used for long walks inside the facility and for moving up and down stairs. Figure 9 shows an example of device usage.

The following evaluations were received : “The device was very effective when it fits”, “It was especially effective when climbing stairs”, and “I felt the range of motion of my knees narrow, but this was resolved by getting used to the knee supporter and the way it fits”.

### 1.4 Development Model of Robot Vacuum Cleaner

Figure 10 shows the development model of the robot vacuum cleaner. It is equipped with a camera and LiDAR (light detection and ranging) (Terminology) to automatically recognize the cleaning environment of MPC's (main press centre) common areas and automatically clean every corner. In addition, “nanoe™ X (Note 1)” sanitizes the dust collection box (Note 2) to provide a clean and comfortable facility space.

The functions are as follows.

Equipped function ① : SLAM (Simultaneous Localiza-



Figure 9 Olympic Stadium (Cleaning Section)

(Note 1) The “nanoe” mark is a trademark of Panasonic Corporation.  
 (Note 2) The sanitization effect may differ depending on the condition of the dust in the dust collection box.

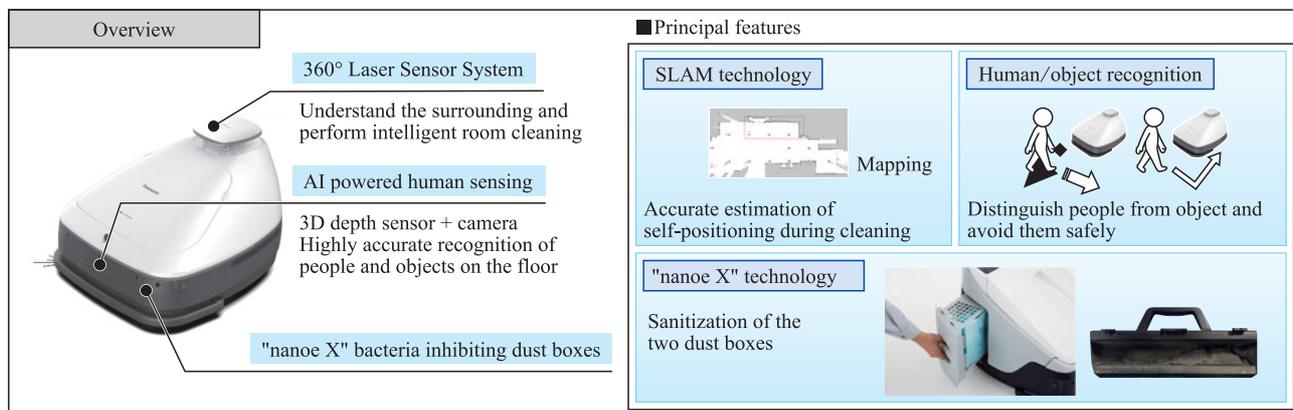


Figure 10 Robot Vacuum Cleaner

tion and Mapping) (Terminology) technology.

The MPC is equipped with a high-precision LiDAR and utilizes SLAM technology for mapping the environment to generate a map of the MPC common area, which is the space to be cleaned. The map-based driving enables driving in a wide area of space.

Equipped function ②: Human/object recognition

Conventional robot vacuum cleaners are designed to operate in spaces with few people. This time, a camera-based recognition technology was installed to operate in spaces where people are present, enabling the robot to move in response to people and objects.

- ① If there is a person in front of the robot, it stops and greets the person.
- ② If there is an object in front of the robot, it continues to avoid the obstacle and cleans the area.

Equipped function 3: Sanitization of dust collection chamber by nanoe™

The health hazards caused by dust during garbage collection are reduced by equipping the robot with a function to sanitize the garbage by performing nanoe™ sterilization in the dust collection chamber after cleaning.

Testing organization: TECHNO SCIENCE CO., LTD.

Test method: Measured the number of bacteria adhering to a piece of cloth in the dust collection box in a test room (approximately 6 tatami mats)

Method of inhibition: nanoe™ released

Object: Adhered bacteria

Test result: 99% or more suppression in 2.5 hours (No. 20070646-001)

Date of test report issued: March 5, 2021 (test was conducted on two types of bacteria), not effective for all bacteria.

#### 1.4.1 Utilization: Main Press Centre (MPC)

From July 19 to September 5, 2021, the common area floor of the Main Press Centre at Tokyo Big Sight was cleaned to reduce the workload of the cleaning crew during the Games. Figure 11 shows an example of the use of this system.

The robot vacuum cleaner was handy during the Games.

In addition, there were requests at the Games for the robot to clean the meal and rest areas for volunteers instead of just the lobby.



Figure 11 Application of Robot Vacuum Cleaner at MPC

## 2. Conclusion

This project aimed to show that the robot vacuum cleaners and the Power Assist Suits are helpful in everyday work and that many people can see them. We believe that the results of their use by many people have contributed to the Tokyo 2020 Games and advanced the social implementation of robots. On the other hand, we also received comments on issues and improvements that should be made using the robot. We want to make the most of these suggestions for future development.

In carrying out the Tokyo 2020 Robot Project, we thank the Organising Committee, the Innovation Promotion Office, and many other stakeholders involved in the project for their assistance in making the robots available in many places during the Tokyo 2020 Games. We express our deepest gratitude to all of them.

We would also like to thank everyone who operated and used our robots.

Thank you very much for your cooperation.

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He graduated from the Graduate School of Systems Information Science, Kyushu University, in 2002. He joined Matsushita Communication Industrial Co., Ltd. the same year and was transferred to the Tokyo Olympic & Paralympic Enterprise Division in 2016, where he participated in the Tokyo 2020 Robot Project. He is in charge of leading the promotion of robot vacuum cleaners and the Power Assist Suits for use in the Tokyo 2020 Games.



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He graduated from Kobe City College of Technology in 1985. He joined Matsushita Electric Industrial Co., Ltd. in the same year. He was transferred to the Tokyo Olympic & Paralympic Enterprise Division in 2014, where he was in charge of creating new businesses around accessibility as the head of the Paralympic Division.



**KUROKAWA Takahiro**

He graduated from the Tokyo Institute of Technology in 1994. He joined Matsushita Electric Industrial Co., Ltd. in the same year. He was transferred to the Tokyo Olympic & Paralympic Enterprise Division in 2015, where he was in charge of creating new businesses related to accessibility and robotics. His goal is to create a society where everyone can use robots, starting with the Tokyo 2020 Games.



**HONDA Renji**

He graduated from the Graduate School of Science and Technology, Kumamoto University, in 2001. He joined Matsushita Electric Industrial Co., Ltd. the same year and was transferred to the Appliance Company in 2016, where he was in charge of advanced development for cleaners. He was involved in the development of the MC-GRS1M (RULO Pro) commercial robot vacuum cleaner. HE was also the development leader for the development model of a robot vacuum cleaner demonstrated at the Tokyo 2020 Games.

