Event Reports

5G Open House Exhibition Report

DOCOMO Open House 2020 —Dawn of the 5G Era and the Future Beyond—

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For two days, January 23 and 24, 2020, "DOCOMO Open House 2020 —Dawn of the 5G Era and the Future Beyond" wad held at Tokyo Big Sight. This article introduces the scene at this event, and describes its main exhibits in detail.

1. Introduction

For two days, January 23 and 24, 2020, NTT DOCOMO held "DOCOMO Open House 2020 —Dawn of the 5G Era and the Future Beyond" at Tokyo Big Sight (**Photo 1**).

NTT DOCOMO looks beyond 2020 and works together with its business partners (hereafter referred to as "partners") to exceed customer expectations and provide customers with surprise and excitement, and aims for co-creation of new value with its partners. This event had been positioned as a place to convey advanced technologies and capabilities to the world based on examples of collaborative innovation with partners in various fields, but this time, NTT DOCOMO has gone further and made efforts to give visitors a taste of the future it draws from the user's perspective. At the venue, we and our partners who are promoting collaborative creation introduced the latest technologies for 5G, AI and IoT, etc. and business solutions using these (**Photo 2**). The exhibition also featured various lectures and programs, and we introduced the "DOCOMO 202X CONCEPT" that embodies the lifestyles of future imagined by NTT DOCOMO. This successful event attracted attention because it was the first year of provision of 5G commercial services. The number of visitors was approximately 24,000, an increase of approximately 10,000 compared to last year.

This article describes details of the main exhibits at the event.

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Photo 1 The scene at DOCOMO Open House

Photo 2 Business creation

2. Event Overview

The event featured 286 exhibits classified into the 10 categories of AI, Device / UI / UX, Digital Marketing, IoT, Business Creation, Global, 5G Vision, 5G Lifestyle, 5G Business, and 5G Future & Technology (**Photo 3**). At the exhibits, visitors were informed of NTT DOCOMO's vision of the future through hands-on experiences of operating actual machines and demonstrations.

In lectures, President and CEO Kazuhiro Yoshizawa gave the keynote lecture on the first day introducing NTT DOCOMO's targeted future and medium-term strategies for the 5G era, entitled "5G, The coming of a richer future" (**Photo 4**). On the second day, Hiroshi Nakamura, Executive Vice President, gave a lecture entitled "Opening the 5G Era and Realizing a Sustainable Society", in which he talked about a society realized by the convergence of the real world with cyberspace in the future where 5G, communication technology of the following generation, and AI are widely used (**Photo 5**).

Photo 3 5G Vision

Photo 4 The keynote lecture by President and CEO Kazuhiro Yoshizawa

Photo 5 Special lecture by Executive Vice President Hiroshi Nakamura

As well as NTT DOCOMO, lectures on various themes were also given by Naomi Tomita (hapi-robo st, Inc., Huis Ten Bosch Co., Ltd.), Rony Abovits (Magic Leap, Inc.), Daisuke Ohata (former Rugby Japan team member, Kobe Steel Rugby Team Kobelco Steelers Ambassador), etc.

3. DOCOMO 202X CONCEPT

This pavilion focused on some of the exhibits at the venue and expressed the lifestyles of future imaged by NTT DOCOMO in six scenes as HOME, MOBILITY, CAFE, LIBRARY, HALL and ARENA. As hands-on experience exhibits with technical explanations kept to a minimum, these exhibits introduced user experiences of the future that can be obtained by combining these various scenes.

For example, HOME exhibited a scene in which AI grasps the body condition of a resident when he or she wakes up in the morning, and switches the indoor environment to more comfortably suit the mood or state of the resident. Combinations of the following exhibits enable the scenes.

(1) A monitoring solution for the elderly: In consideration of privacy, this solution enables acquisition of the residence health status, position and posture without the use of a video camera.

(2) Smart home, future house project: AI-based solutions for providing users with recommendations and controlling IoT devices by various IoT sensors collecting the resident's data.

Another scene demonstrated smartphone charging that starts automatically using "long-distance wireless charging*1" technology when entering a café, and "Osaifu-Keitai touchless" technology that links Ultra Wide Band (UWB)*2 with various radio

*1 Wireless charging: Transmission of power without an electrical connection. Power transmission can be accomplished by an electromagnetic scheme, by optical means, or by sound waves, etc.

*2 UWB: A wireless communications system with a signal bandwidth that exceeds 500 MHz.

standards so that the smartphone can complete the payment from the user's pocket just by the user standing in front of the cash register.

The daily life scenes shown in this pavilion are not merely pipedreams but represent a future that can be realized based on the technologies of NTT DOCOMO and its partners (**Photo 6**, **7**).

4. VMocap - 3D Digitalization of Human Movement Using Cameras

At this booth with a circular stage, a marker-less motion capture technology that works in wide-space and multi-person environments was demonstrated and attracted the attention of many visitors (**Photo 8**, **9**, **Figure 1**).

This technology was developed jointly with the Nakamura and Yamamoto laboratory of the Graduate School of Information Science and Technology, the University of Tokyo. The demonstration was realized by applying the "VMocap" technology developed by the laboratory, which enables motion capture only from camera images.

Generally, special equipment or suits are required to perform motion capture, which limits measurement locations and usage scenes. However,

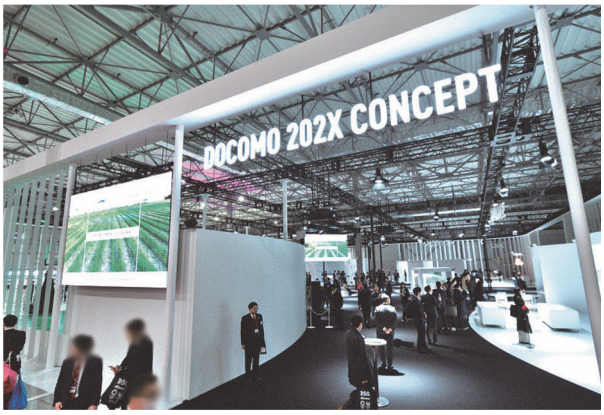

Photo 6 The DOCOMO 202X CONCEPT entrance

Photo 7 DOCOMO 202X CONCEPT sports viewing

Photo 8 The scene at the demonstration

Photo 9 The scene at the venue

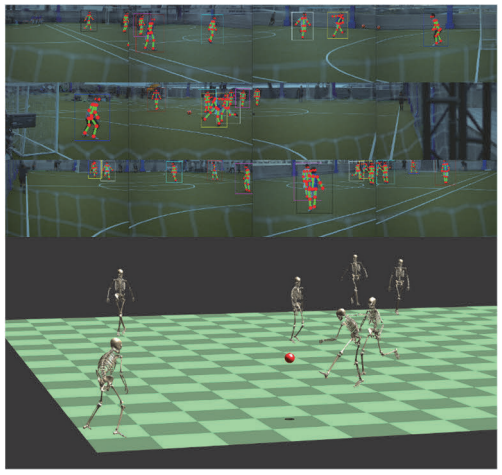

Figure 1 Sample output of the video motion capture

this technology realizes multi-person marker-less motion capture in a wide space by automatically selecting and switching optimum images for analysis from multiple cameras. In addition, even in the situation where human bodies overlap on the image, the technology predicts the human movement robustly by utilizing the human skeletal model, continuity of the motion and the latest image recognition technology. Even in a scene where multiple players move around dynamically such as a game of futsal, the technology can obtain high-accuracy and smooth motion and bone movement (**Figure 2**).

In the future, this technology will be applied to sports such as soccer, baseball, gymnastics, figure skating, etc., and utilized for training, tactical analysis, prevention of injury and motion archiving. In addition, it will also be used to create 3D animations in the entertainment field and evaluate exercises in the nursing and rehabilitation fields.

5. Future Lifestyles Achieved with AR Clouds

Regarding Augmented Reality (AR)*3/Mixed Reality (MR)*4, which will bring innovative communications, we used "AR cloud" technology to present a demonstration exhibition that conjured the lifestyles of the future.

The AR cloud is technology that provides a common AR/MR experience across different devices such as AR glasses, Virtual Reality (VR)*5 goggles and tablets, etc. by using self-localization technology that collects data about the spatial structure in the exhibition booth in advance, builds a digital twin*6 that is a copy of the real space, and aligns the real space with the digital twin using a feature

*3 AR: Technology for superimposing digital information on real-world video in such a way that it appears to the user to be an actual part of that scene.

*4 MR: Technology for superimposing digital information on video taken of the real world and presenting the result to the user. In contrast to AR, MR makes information appear as if it's actually there in the real world from any viewpoint.

*5 VR: Technology that gives the user the illusion of being in a virtual world. In recent years, this illusion is mainly achieved using HMD

point map*7.

The exhibition featured two simulated areas: an outdoor cityscape inspired by an old town, and an indoor living room (**Figure 3**). Visitors experienced a wide range of content fusing the cyber and the physical on three devices, Magic Leap 1*8, Mirage Solo and iPad*9, such as being provided with coupons for nearby (simulated) stores, etc. according to their location, multiple paper cranes flying out from noren curtains, bus arrival times estimated with consideration of traffic congestion displayed on a bus stop, text messages displayed above the heads

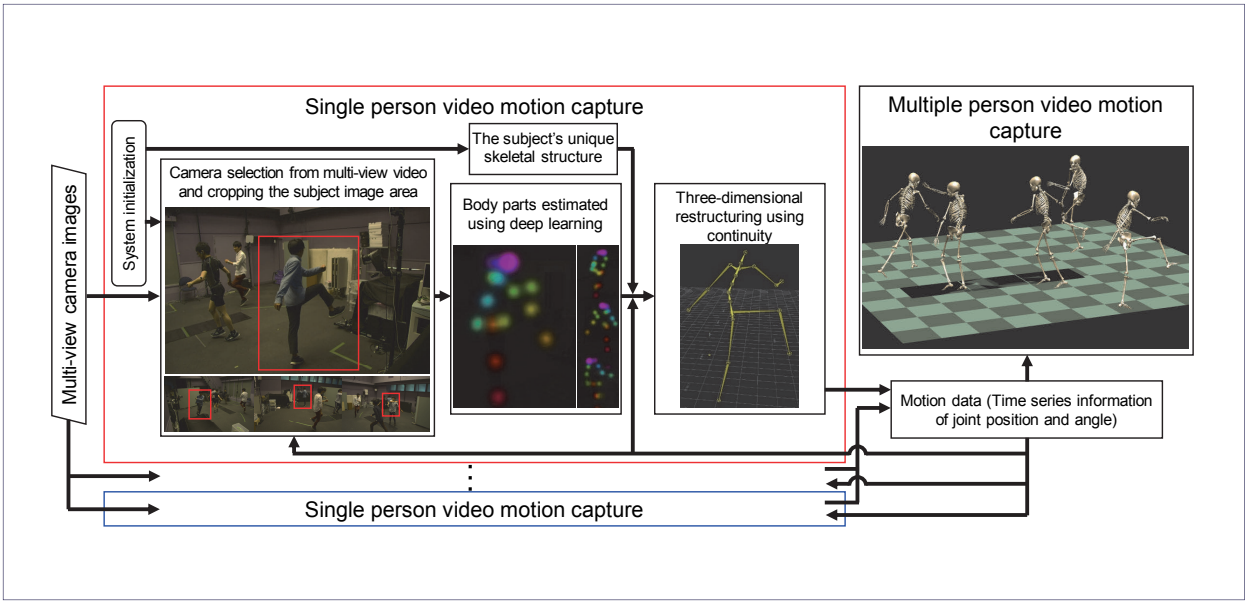

Figure 2 Flowchart of VMocap

Figure 3 Overview of the exhibition booth

*6 Digital twin: A real-time reproduction in the digital world of the position, shape, and various sensor information of various objects in the real world.

*7 Feature point map: A collection of image feature points from which camera images have been extracted, which are required to align (self-position recognition) real space with digital twins.

*8 Magic Leap 1: "MAGIC LEAP", MAGIC LEAP 1, the Magic Leap logo and all other trademarks are trademarks of Magic Leap, Inc.

of people by tracking their movements, virtual pets, and living rooms turning into beautiful sandy beaches in an instant (**Photo 10**, **Figure 4**).

Many visitors wanted to experience Magic Leap 1, and we heard much positive feedback about the world of the AR cloud experienced with these cutting-edge spatial computing devices.

6. Flexible 5G Area Formation with Transparent Dynamic Metasurface

To flexibly develop areas with the millimeter wave band used for 5G and later generations, a prototype of a "Transparent Dynamic Metasurface"*10 developed by NTT DOCOMO and AGC Inc. (hereinafter referred to as "AGC") was exhibited, and demonstration experiments were introduced by video. Last year, NTT DOCOMO exhibited a metamaterial*11 reflector that allows the direction and beam shape of reflected waves to be designed at the same event, but there were some issues. While the metamaterial reflector is effective for expanding an area, it needs to be designed to suit the installation location, the back of the reflector is out of line of sight which degrades communication quality, and the device can also affect the scenery. To address these issues, NTT DOCOMO proposed a new principal and designed a device, while AGC studied the material and microfabrication technologies and manufactured it. We presented this new transparent dynamic metasurface at the exhibition.

This transparent dynamic metasurface achieves a large substrate surface area and dynamic control of the transparency/reflection ratio while maintaining transparency, by tiny micron-level (μm) movement of the glass plate layered on the transparent metasurface to widely vary the metasurface transparency/reflectivity characteristics (**Photo 11**).

At the venue, we also exhibited a video of a

Photo 10 Customers enjoying the demonstration

Figure 4 Contents actually displayed on an iPad

Photo 11 The transparent dynamic metasurface exhibited

*9 iPad: Apple, the Apple logo and iPad are trademarks of Apple Inc. registered in the United States and other countries. TM and ©2020 Apple Inc. All rights reserved.

*10 Metasurface: An artificial surface technology with two-dimensional periodic arrangement of structures that is a type of artificial medium (metamaterial) that achieves an arbitrary dielectric constant and magnetic permeability by periodically arranging structures that are smaller than the wavelength.

*11 Metamaterial: An artificial material that causes electromagnetic waves to behave in ways that they do not in natural materials.

January 2020 demonstration of nearly loss-free transmission/reflection control of radio waves with a bandwidth of 400 MHz or more in the 28 GHz band, and showed that it's possible to flexibly construct 5G areas with the transparent dynamic metasurface more meticulously by dynamically controlling wave propagation without adversely affecting scenery (**Figure 5**, **Photo 12**).

7. Conclusion

This article introduced the scene at "DOCOMO

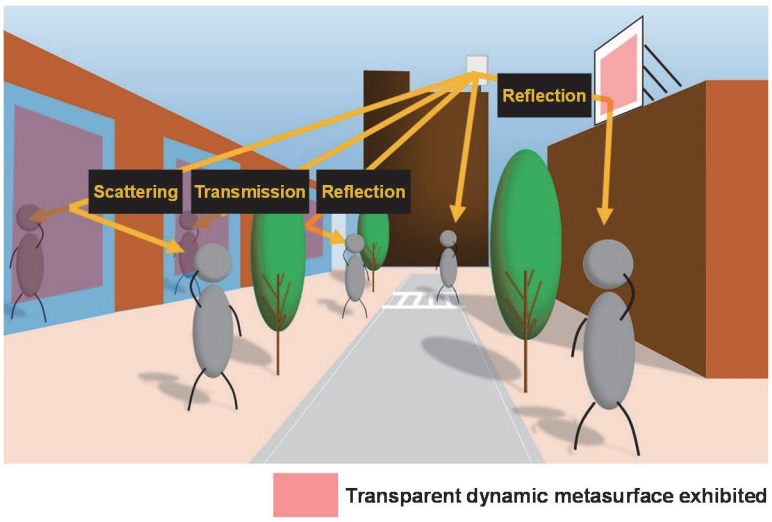

Figure 5 Future use case image

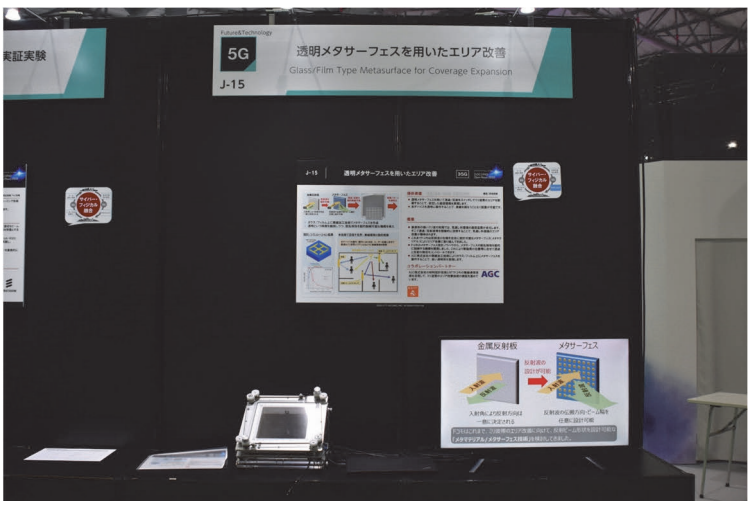

Photo 12 An exhibit

Open House 2020 —Dawn of the 5G Era and the Future Beyond—" held on January 23 and 24, 2020, and described some of its exhibits.

NTT DOCOMO has launched full-scale 5G commercial services and is creating fun and surprising services to innovate customer lifestyles and communications of the future while aiming for the growth of Japan and the prosperity of society, and is making efforts to solve social issues.