

Market Report

VR/AR (Industrial Solutions)

October, 2017



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- This report covers virtual reality as used in industrial solutions, and does *not* cover virtual reality used for games or entertainment purposes.
 - Information in the report covers VR-related hardware, software, and contents.

Summary

- Both globally and in Japan, the size of the VR/AR market is expected to grow more than 10 times larger over the next five years.
- VR/AR Trends in Japan
 - Up until now, VR/AR has largely been used in Japan for entertainment purposes. However, in the coming years, it is expected that the technologies will be applied in a wide variety of industries, such as medicine, tourism, retail, and manufacturing.
 - Many players, including Japanese electronics manufacturers, have been providing VR/AR technologies for industrial solutions.
 - Foreign companies are also aiming for opportunities to commercialize VR/AR technologies.
 - Research in VR/AR technologies and human responses has been making progress at universities and research institutions.
- Exhibitions focused solely on VR/AR are few in number, with more numerous opportunities found in introducing VR/AR as one of many technologies for a specific industry.

1. VR/AR Market Overview

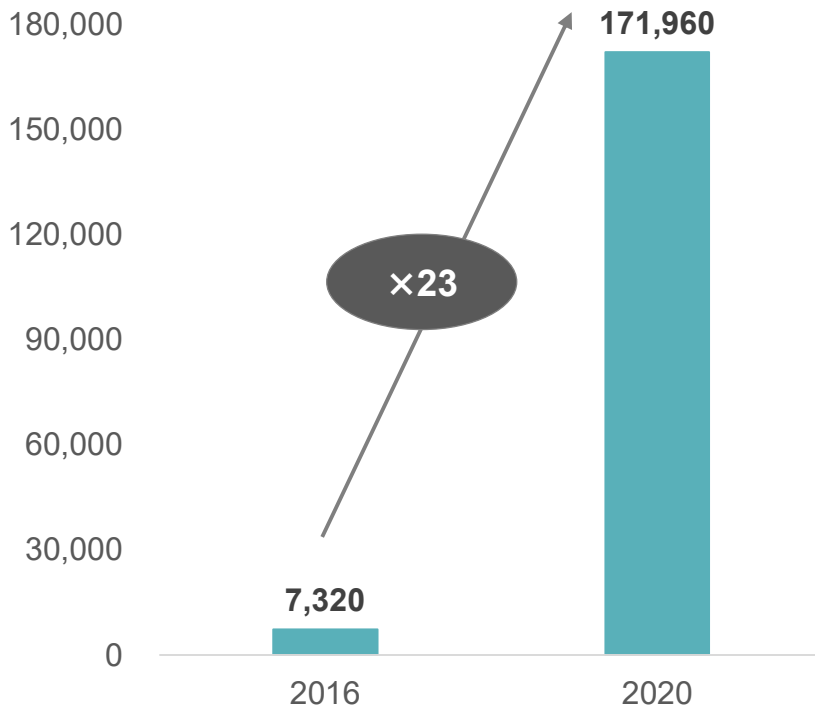
i. Global and Japanese VR/AR Markets

Estimated Growth of the VR Market

- In 2016, the size of the global VR/AR market stood at 732 billion yen,^{*1} and is projected to exceed 17.196 trillion yen by 2020.^{*1}
- In 2016, the size of Japan's VR/AR market was around 14.1 billion yen, and is estimated to grow to 211.1 billion yen by 2020.

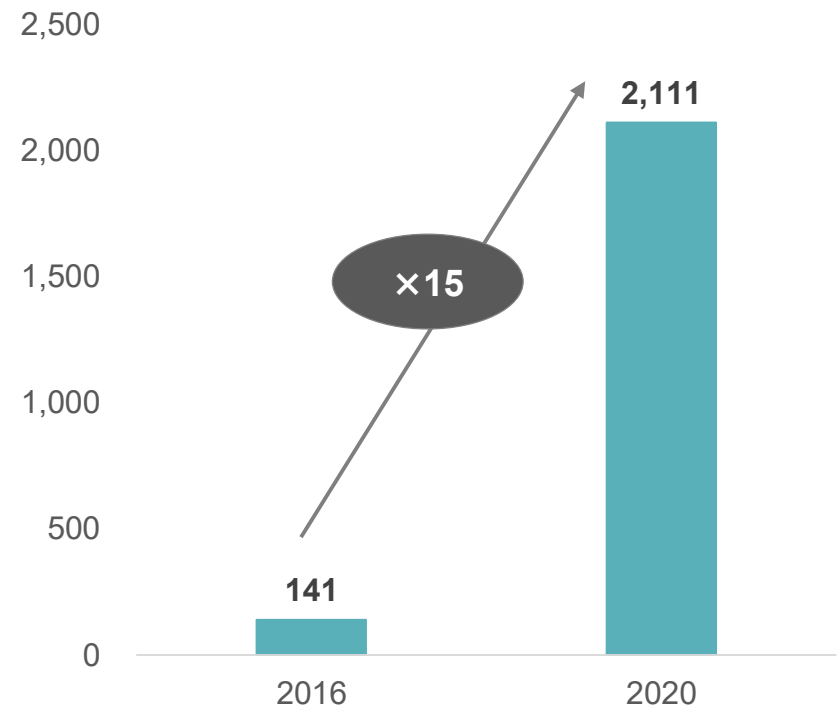
Size of the Global VR/AR Market (estimated)^{*1, 2}

(in 100M's of yen)



Size of Japan's VR/AR Market (estimated)^{*3}

(in 100M's of yen)



^{*1} Calculated at USD1=JPY120

^{*2} Expenditure calculated for hardware, software, and VR/AR-related services. Source: IDC press release, 'Worldwide Semiannual Augmented and Virtual Reality Spending Guide'

^{*3} Expenditure calculated for hardware, software, events, and fees from trying out VR/AR products at stores, etc. Source: MM Research Institute, 'Consumer Use of AR and VR and Survey on Market Size'

1. VR/AR Market Overview

ii. Hardware

In the domestic VR/AR hardware market, recent developments among companies are as follows.

Recent Corporate Developments in VR/AR Hardware*1



Article Date	Company	Industry	Initiatives
Apr. 2017	Huáshuò Diànnǎo (ASUS)	Electronic goods	In summer of 2017, plans to launch a SIM free smartphone, the ZenFone AR, on the Japanese market. The phone is capable of supporting VR and AR platforms.
Feb. 2017	Koei Tecmo	Entertainment	Developed a VR device which enables users to experience smells. The machine accommodates one user at a time, sending out smells as users wear a Sony headset. Product is expected to go on sale sometime in 2017.
Jan. 2017	JDI	Electronic goods	Announced a new display model for VR devices.
Jan. 2017	Honda, DreamWorks	Automotive/ Entertainment	Working together on a new form of in-car entertainment. Joint development is being carried out on a system where users wear VR headsets to enjoy various games inside a virtual reality environment. The games will match the movements of the vehicle.
Dec. 2016	Nokia	Electronic goods	Began selling its in-house developed 360-degree stereoscopic VR camera, Ozo.
Nov. 2016	Alps Electric	Electronic goods	Is developing a VR haptics device that utilizes motors and other electronic components to simulate sensations such as hardness or warmth when holding an object. Aims to sell 10 billion yen's worth of units by 2020.
Sept. 2016	AOI	Advertising	Is developing a virtual reality baseball system that uses a VR headset and a bat with embedded sensors. Data on professional pitchers is taken from official matches and analyzed, reproducing pitching speed, ball rotations, and the sense of touch.
Aug. 2016	Accessories 4 Technology	Electronic goods	Began selling its smartphone VR headset, Stealth VR Pocket, in Japan.
Jul. 2016	Elcom	Electronic goods	Stepped up activities in their VR devices business. Made a series of investments in 32 products, including virtual reality glasses that can be paired with a smartphone to view images in 3D.
Jul. 2016	NEC	Electronic goods	Is developing a system that utilizes AR. The system enables users to employ gestures to control a projected screen in front of them. Demand is expected to come from sites requiring sanitation, such as medical sites and food processing sites.

*Red indicates foreign companies.

*1: Articles from The Nikkei newspaper over a one year period (dated from May 24, 2016 – May 23, 2017) were searched, and most recent articles on VR/AR selected.

1. VR/AR Market Overview

iii. Software

In the domestic VR/AR software market, recent developments among companies are as follows.



Recent Corporate Developments in VR/AR Software*1

Article Date	Company	Industry	Initiatives
May 2017	SoftBank, Improbable	Communications, software	SoftBank invested in UK-based company, Improbable, which works on development tools for virtual worlds and simulations.
Apr. 2017	GrapeCity	Software	Began sales of Wikitude SDK 6, the latest version of the Wikitude SDK for developing AR apps.
Oct. 2016	Hakuhodo	Advertising	Established the dedicated VR/AR company, Hakuhodo – VRAR, and partnered up with Kudan to work on software.
Jul. 2016	Kudan	Software	Develops and sells AR engines at both its UK and Japan base. Has received a totally of 203 million yen in funding from individual investors in Japan, Hong Kong, Singapore, and other countries.
Jun. 2016	InstaVR	Software	Developed tools for creating VR contents (e.g. virtual reality smartphone apps) that enable development without requiring any specialist knowledge.

*Red indicates foreign companies.

1. VR/AR Market Overview

iv. Contents

In the domestic VR/AR contents market, recent developments among companies are as follows.



Recent Corporate Developments in VR/AR Contents*1

Article Date	Company	Industry	Initiatives
Apr. 2017	J Sports	Broadcasting	In the same month, began offering VR sports videos. Users can use a smartphone to view contents such as baseball player training sessions, etc.
Mar. 2017	VR Park Tokyo	Entertainment	Visitors can enjoy virtual reality bungee jumps and battles. Opened in Dec. 2016.
Mar. 2017	Yuke's	Entertainment	Debuted ARP, an artist created from VR technologies. Began selling CDs and DVDs.
Mar. 2017	Thee Moment	System development	Launched a problem-solving AR app at the Kashii Kaen fun park in Fukuoka City. The app is part of a treasure hunting game where guests can participate in a hunt around the park itself.
Mar. 2017	Adores	Entertainment	Ran a midair virtual reality attraction at the VR Park Tokyo.
Mar. 2017	Bandai Namco Entertainment	Entertainment	In summer of 2017, will open a large AR/VR facility in Shinjuku, Tokyo, with a total floor area of around 3,600 m ² . Expected to become biggest VR facility in Japan.
Jan. 2017	Minamihama Tsunagu Kan	Public	Ran an exhibition that let people use headsets to get a 360 degree view of the Tohoku Earthquake disaster zone a month on.
Jan. 2017	B.League	Entertainment	Provided part of the B.League's first all-star game as a virtual reality experience.
Jan. 2017	Avex	Entertainment	Launched a "VR theater" which employs holograms and 3D images to mimic a live concert experience for popular artists.
Jan. 2017	Universal Studios Japan	Entertainment	Set up a virtual reality rollercoaster ride using the Evangelion anime.

2. Developments among VR/AR Players in Japan

i. Main Players in Japan's VR/AR Market

The main VR/AR players in each of the categories (hardware, software, contents, other) are listed below.

Main VR/AR Players in Different Categories

Category	Major Players
Hardware	Fujitsu, NEC, Honda, Koei Tecmo, Alps Electric
Software	GrapeCity, InstaVR
Contents	Bandai Namco Entertainment, Avex, Universal Studios Japan, J Sports
Other (VR services, etc.)	AOI Pro (contents planning/consulting), A440 (contents planning/consulting), Omnibus Japan (contents planning/consulting), Creek & River (contents planning/consulting), Ask (trading company)

2. Developments among VR/AR Players in Japan

ii. Industrial Solutions Offered by Large Japanese Companies

Japanese electronics manufacturers have been actively working on initiatives in industrial solutions.

Developments by Major Japanese Companies in VR/AR Industrial Solutions

	NEC	Fujitsu	Toshiba (Toshiba System Technology)
Hardware	<p>Developed ARmKeypad Air, a contactless keypad for use at worksites where direct contact with objects is not possible</p> <ul style="list-style-type: none"> Utilizes smart glasses and image recognition technology to display a virtual keyboard on the user's forearm and allow contactless operation. 	<p>Launched zSpace, a display that converts projected contents into virtual reality</p> <ul style="list-style-type: none"> Uses a combination of glasses, a stylus, and a dedicated display. Stylus vibrates when user grabs a projected object. Offers its development documents for free. 	<p>Developing VR work training system that provides workers with “realistic” training</p> <p>No information</p>
Software	No information	<ul style="list-style-type: none"> Plugin for the Unity game development platform supports development on said platform. Comes with 3D model viewer, enabling users to utilize existing 3D model data. 	No information
Contents	<ul style="list-style-type: none"> Keypad is expected to be used at food processing sites (where bacterial transfer through contact is an issue), worksites where hands can get covered with oil or other substances, and medical sites, (where sanitation is an issue). 	<ul style="list-style-type: none"> Wide range of usage envisioned – from education to manufacturing and medicine. Has been well received and seen rapid growth in the educational sector in particular, with 10,000 units already in use in the US. 	<ul style="list-style-type: none"> 3D models can be rotated, moved, expanded and shrunk. Work procedures can be replicated or guidance provided. To be used in confirming construction progress, introducing products, reviewing designs, evaluating operability/safety, etc.

2. Developments among VR/AR Players in Japan

iii. Expanded Usages for VR/AR in Japan (Medical)

Medical solutions startup, HoloEyes, provides a “virtual anatomical drawing”, which enables surgeons to utilize 3D anatomical visualizations of patients to carry out more precise operations and simulate surgeries.

Overview

Developed by HoloEyes COO, Dr. Maki Sugimoto, the “virtual anatomical drawing” is a system that uses patients’ CT imaging data to create a 3D anatomical model. Doctors can then use head-mounted displays to get a 360 degree view of the patient’s anatomy, and **carry out more precise operations and simulate surgeries.**



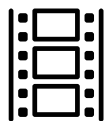
Hardware

- ✓ Can be used with VR head-mounted displays generally sold on the market.



Software

- ✓ The system uses the OsiriX open source application (developed by the OsiriX Foundation) for creating and viewing the 3D anatomical drawing, enabling anyone to freely customize it.



Contents

- ✓ Creation and viewing of the virtual anatomical drawings uses the medical image analysis application, OsiriX, which converts images from CT scans into 3D. 2D image data can also be rendered into 3D with a few clicks.

2. Developments among VR/AR Players in Japan

iii. Expanded Usages for VR/AR in Japan (Retail)

New experiences in virtual reality fashion have begun to appear in major department stores and other retail establishments.

Overview

Developed by Psychic VR Lab Co., Ltd., Styly is a VR platform supporting **contents that provide a first-of-its-kind shopping experience at department stores, etc.** Users can experience virtual spaces instilled with the unique perspective of various fashion brands, and “experience” information about manufacturers through films.



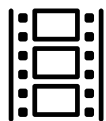
Hardware

No information



Software

No information



Contents

- ✓ Using virtual reality contents, shopping experiences like never before will be provided, enabling shoppers to experience scenarios such as Tokyo in 2037, being in outer space, or shopping for clothes in a virtual world.

2. Developments among VR/AR Players in Japan

iii. Expanded Usages for VR/AR in Japan (Tourism)

Major Japanese travel agency, H.I.S., has launched augmented reality travel pamphlets, requiring users only to have a smartphone to enjoy the contents.

Overview

H.I.S., one of Japan's largest travel agencies, **launched a “moving pamphlet”** that provides videos of tourist spots taken by drones, etc., giving the sense of images leaping out of the screen.



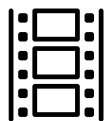
Hardware

- ✓ To view the contents, users only need to use the designated smartphone app to scan photos with an embedded AR marker.



Software

No information



Contents

- ✓ Drone videos taken of tourist spots such as Dubrovnik in Croatia, or Hallstatt in Austria, can be viewed on smartphones. AR technology makes the images appear to pop out of the pamphlet.

2. Developments among VR/AR Players in Japan

iii. Expanded Usages for VR/AR in Japan (Manufacturing)

Research continues to progress into utilizing marker-based AR technologies in managing materials, etc., at manufacturing sites.

Overview

NTT Data Engineering Systems is currently developing AR technology that can aid workers at manufacturing sites in finding required objects from among massive amounts of stored molds, electrodes, and other materials.

By holding a smartphone or tablet up to an object, information and a drawing of the object will appear on screen.



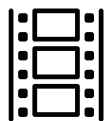
Hardware

- ✓ Can be used with smartphones and tablets generally sold on the market.



Software

No information



Contents

- ✓ Smartphones and tablets can be used to confirm part numbers recorded in AR markers, original drawings, customer information, and design details (dimensions and tolerance data, etc.).

2. Developments among VR/AR Players in Japan

iii. Developments among Foreign Companies in Japan's VR/AR Market (DreamWorks)

Leading US animation studio, DreamWorks, entered into a partnership with Honda. With the spread of self-driving vehicles in mind, the partnership plans to work on utilizing VR in new forms of in-car entertainment

Overview

At the consumer electronics tradeshow, CES, held in January 2017 in the US, **Honda announced that in partnership with DreamWorks, the two companies are currently developing 'Dream Drive', a development kit for creating VR in-car entertainment software.**



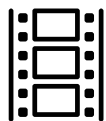
Hardware

- ✓ Development kit's most prominent feature will be the linking between VR headset and live telematics to provide entertainment in sync with the real-time movements of the vehicle.



Software

- ✓ Developing a development kit for entertainment software that adapts to vehicle movements (after completion, kit could potentially be made available to other companies).



Contents

- ✓ In addition to development kit, DreamWorks' catalogue of animated contents will also be offered.
- ✓ In future, also potential for several Dream Drive systems to connect online and allow users to communicate or play games with one another.

2. Developments among VR/AR Players in Japan

iv. Developments among Foreign Companies in Japan's VR/AR Market (Microsoft)

Microsoft collaborated with Tokyo VR Startups (an incubation program that specializes in virtual reality) to provide Microsoft BizSpark, a program providing support to startups through free cloud services and development tools.

Overview

A subsidiary of Japanese social gaming company, Gumi, and provider of an incubation program for VR/AR startups, **Tokyo VR Startups has partnered with Microsoft. The partnership announced that Microsoft BizSpark, a program providing support to startups with free cloud services and development tools, would be provided to companies in the incubation program.**



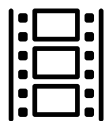
Hardware

No information



Software

- ✓ InstaVR, one of the companies participating in Tokyo VR Startups' incubation program, provides the authoring tool, InstaVR, which developers can use to quickly create VR apps and distribute to various VR platforms.



Contents

- ✓ HoloEyes, a company participating in Tokyo VR Startups' incubation program, provides VR and AR tools that enable 3D viewing of a person's internal organs or diseases, and is building a 3D human body data library to provide to medical professionals.

2. Developments among VR/AR Players in Japan

iv. Developments among Foreign Companies in Japan's VR/AR Market (ASUS)

ASUS announced plans to launch a VR and AR platform-supporting smartphone in the Japanese market in the summer of 2017. Both individual consumers and companies are the expected customers for the product.

Overview

In April 2017, ASUS announced that it would launch its new smartphone, the **ZenFone AR, on the Japanese market in the summer of the same year**. The phone's main feature is its **ability to support Google's AR technology, Tango, and Daydream VR platform**.



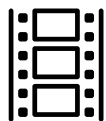
Hardware

- ✓ Utilizes the ASUS TriCam System, which comes with a 23 million pixel camera, a motion tracking camera, and a depth-sensing camera. An infrared sensor is able to recognize the surrounding environment, altogether making the model highly equipped to support VR and AR.



Software

- ✓ Comes installed with Google's AR technology, Tango, which can recognize anteroposterior relationships between objects, and distances, etc.
- ✓ Supports Google's VR platform, Daydream.



Contents

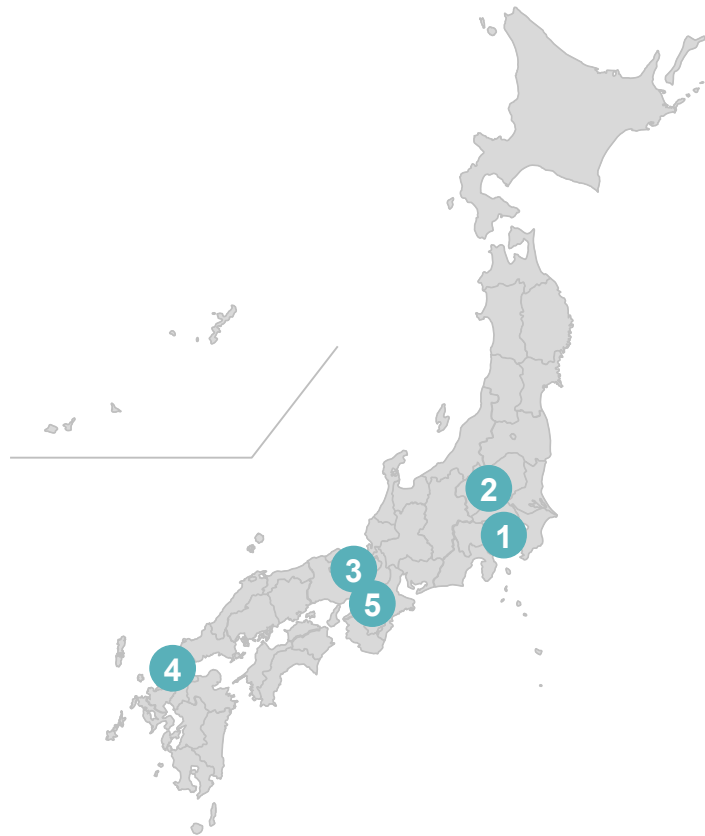
- ✓ To cultivate demand from corporate customers, the company is looking into development of a virtual room app that allows users to try different furniture layouts, and then provide the app to interior design stores, and other relevant businesses.

2. Developments among VR/AR Players in Japan

v. Research Institutions

Research and development in VR/AR is also making progress at domestic research institutions. Recent initiatives undertaken by major institutions are as follows.

Recent Initiatives by Research Institutions in the VR/AR Field (Top 5 by KAKENHI Grant)



Institution Name	KAKENHI Grant* ¹ (in 1M yen)	Recent Initiatives* ²
University of Tokyo	626	Furthering the “Human Augmentation” program in collaboration with Sony (Mogura VR, Mar. 13, 2017) Developing AR/VR technologies that could enhance capabilities of humans. Endowed chair by Sony.
RIKEN	459	Clarifying recognition mechanisms in VR space (RIKEN press release, May 2, 2017) In an experiment using mice, discovered that the hippocampus part of the brain and the function of the autism-linked SHANK2 gene was important in recognizing destinations in VR spaces.
Ritsumeikan University	395	Building a surgical system to make advanced medical treatment available anywhere (Nikkei Digital Health, Oct. 16, 2014) Applying VR technologies, and using models of patients’ bio-information and surgical processes by veteran doctors, is furthering research for building a multipoint collaboration-based surgery support system.
Kyushu University	307	Developing large-scale tsunami simulation system (NHK website, Mar. 7, 2017) Using VR technologies, is developing a system that will simulate a tsunami hitting cities in the aftermath of a Nankai Trough earthquake. Will be of use in devising evacuation routes and disaster prevention training.
Kyoto University	299	Supporting nuclear decommissioning with AR (The Nikkei, May 8, 2016) In collaboration with the Japan Atomic Energy Agency, is utilizing AR in development of a support system for nuclear decommissioning operations. Tablets will display locations for setting up scaffolding, dismantling instructions, etc., and help prevent mistakes.

*1: Astavision, *Top 50 Ranking of KAKENHI Grants in the ‘Virtual Reality (AR, VR, SR, MR)/3D Projection’ Market* *2: The keywords “VR”, “AR”, “virtual reality” were used alongside research institution names to search for news through Google. News on partnerships with an external party were prioritized for inclusion in this report (where there was no partnership with an external party, the most recent initiative was selected).

3. VR/AR and the Surrounding Environment Incentives, Trade Associations, and Exhibitions

With subsidy schemes being introduced and trade associations being set up, a business environment that can contribute to the growth of VR/AR businesses is taking shape.

Subsidy for Projects Promoting Revitalization of Local Regions through Advanced Technologies for Creating Content*1

The Ministry of Economy, Trade and Industry (METI) is providing subsidies for the costs involved in creating contents that utilize advanced content creation technologies (including VR and AR) to promote the products, services, or tourism of local regions. Maximum of 10M yen per project, with a subsidy rate of 1/2 of eligible costs. Furthermore, METI is to formulate guidelines through this subsidy program for optimal utilization techniques concerning advanced content production and expression technology. Through the dissemination of these guidelines, METI aims to promote the content industry and revitalize local economies.

Target

- Projects where content production companies form a consortium with local businesses (tourism, local products/services), and utilize advanced content technologies (VR/AR, or 'expression technologies' (i.e. VR, AR, simulations, digital cinema, media art, etc.) to promote regional revitalization.

Availability

- The latest round of applications concluded in May 2017. The next round has yet to be decided.

Exhibition Information:

VR/AR World (<http://www.content-tokyo.jp/vrar/> (JPN only))
3D & Virtual Reality Expo (<http://www.ivr.jp/en/Home/>),
Advanced Content Technology Expo (<http://www.ct-ext.jp/en/HOME/>),
Wearable EXPO (<http://www.wearable-expo.jp/en/home/>)

VR/AR-related Trade Associations*2

VR Consortium <http://vrc.or.jp> (JPN only)

- Aim: To gather together the creators developing and providing VR tools, companies, and academia, and become a platform for building a new age.
- Activities: Raising profile of VR, technical development, studies and networking to promote cooperation, holding of conferences/events, etc.
- Participating Foreign Companies: AMD, HTC, NVIDIA, etc.

The Virtual Reality Society of Japan <https://vrsj.org/English/about>

- Aim: To contribute to virtual reality technologies and culture.
- Activities: Publishing of academic journals, dissemination of information, running of domestic events such as the VR Culture Forum, ICAT, IEEE-VR, etc., setting up research panels
- Participating Foreign Companies: Microsoft, Dell, Vuzix, etc.

*1: Visual Industry Promotion Organization website

*2: Organization website