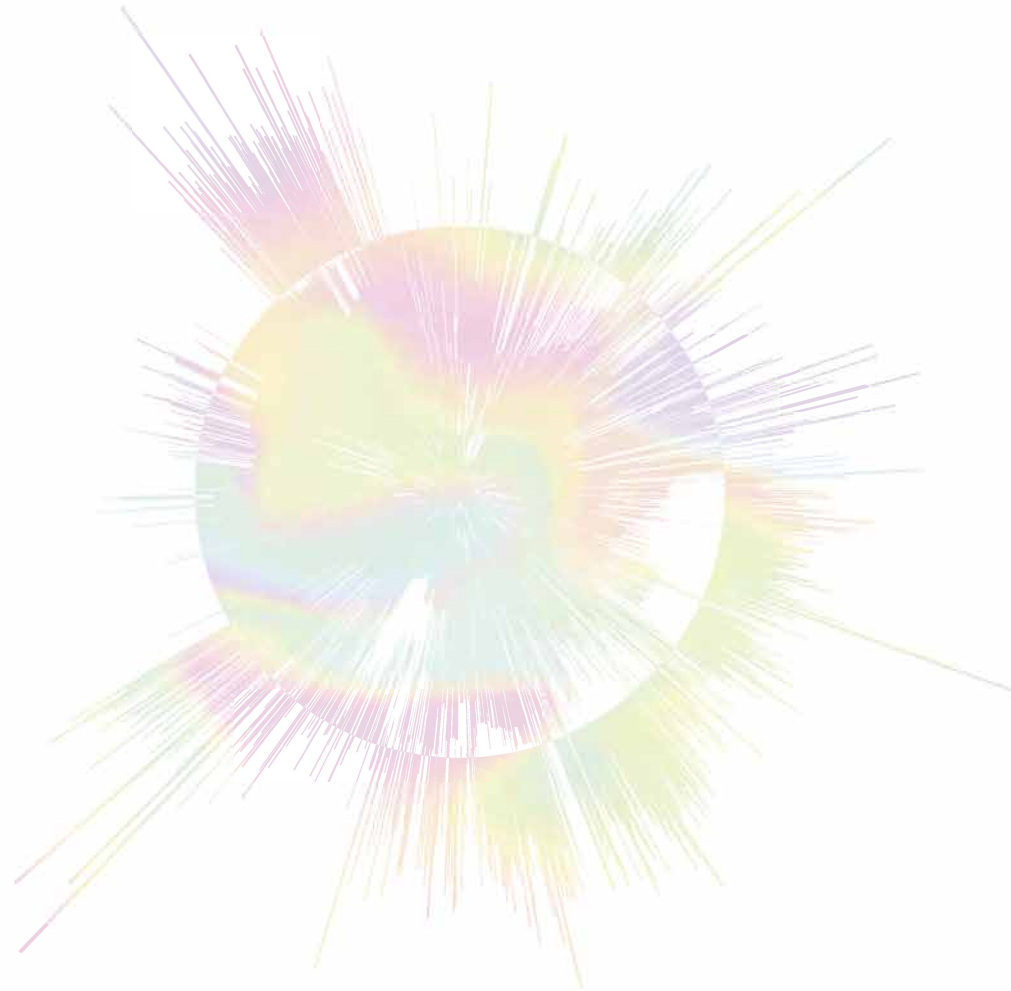


THE  
TECHNOLOGY  
REPORT\_



Issue:01

Spectacle

# THE TECHNOLOGY REPORT\_

Issue: 01  
Spectacle

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# Special Feature: Spectacle

## Deciphering the Future from Desires

Spectacle: Something that makes a strong visual impression. Carries a wide range of meanings, including telescope, scenery, sight, and cataclysm. Derived from the Latin “spectaculum”.

Humans are creatures in pursuit of stimulation. And “spectacle” has always catered to such demands. It stirs emotions and fuels excitement. In chasing such spectacles, people have invented various forms of media and content over time. For instance, the trend of “Instagrammable” moments is a kind of spectacle. We get excited by the endless stream of contents, continually scrolling through them. The stimulating presentations used in social games or pachinko can also be seen as designed spectacle. Such presentations, at times, are paired with other sensory elements like sound or vibration to deliver stronger effects.

However, from 2020 onwards, an irresistible change has arrived. Due to the COVID-19 global pandemic, “gathering” became impossible. Attending any events was no longer an option, and many promoters found a lifeline in virtual live shows streamed over the internet.

With the advent of these streaming technologies, spectacles were liberated from reality. A spectacle designed in a digital environment allowed visual effects that couldn't be experienced in the real world. Simultaneously, new problems emerged. A spectacle, by definition, is realized when there are spectators. However, in venues where audiences couldn't gather in person, the level of excitement and stimulation couldn't match that of real-world spaces.

The evolution of spectacle in the 2020s can be contemplated from three aspects: “augmentation of reality”, “reproduction of more realistic experiences”, and the “re-importation from virtual to real” that occurs when these two values intersect. Now, let's delve into the world of spectacles. Beyond the stimulation and excitement, we should be able to have a glimpse of the shape of the future.

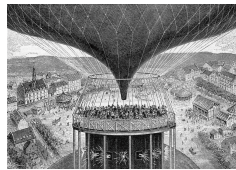
Spectacles have always moved our hearts, regardless of the era. However, their manifestations have not been uniform. They have transitioned from the “phenomena” unfolded by grand nature to the “symbols” formed by technology. This section introduces the transition that spectacles, primarily visual, have undergone alongside the advancement of technology.

## Spectacle as the Beta Version of the Future

Nature is filled with grand spectacles that amaze us. The ever-changing auroras to total solar eclipses darkening the day. Ancient people considered such phenomena as spectacles produced by the powers of gods. For instance, the story that the ancient Greek city of Helike was submerged into the sea overnight “due to invoking the wrath of Poseidon” has been handed down over generations. In ancient China, thunder and lightning were believed to be manifestations of divine power. Therefore, the Chinese character for “god” includes the symbol for lightning. Encountering such extraordinary sights and associating them with mystical powers beyond human understanding seems like a very natural course of thought.

Then, we developed technology. We became capable of creating astonishing scenery ourselves, like vertiginously gigantic tombs, castles and gardens, fireworks, circuses etc. New technology was infused into every place, giving birth to new spectacles. In many cases, spectacles have been utilized as symbols of power or as evidence of affluence. For example, the now increasingly familiar VR (Virtual Reality) experiences. Spectacles that could be called precursors to this were showcased at the Paris 1900 Expo. Let us introduce two examples.

The first was an attraction called “Cinéorama” by Raoul Grimoin-Sanson, which was like a fusion of film and amusement park ride. As the name suggests, it was created by combining “cinema” and “panorama”, being the world’s first attempt to apply



The grandeur of Cinéorama was not just in its projection technique but also in its filming method. A massive 500kg filming apparatus, connecting ten cameras, was developed to simultaneously shoot a 360-degree view. The filming expeditions, undertaken on hot air balloons across various locations, spanned over three years. The total length of the film reached up to 4,000 meters, and each frame of this extensive footage was colored by hand by coloring workers.\*1



The panorama paintings in the background featured Moscow, Omsk, Irkutsk, Beijing, and the Great Wall of China. Even in 1903, a few years after the Paris Exposition, the paintings were not yet completed, and it is said to have been exhibited again at the St. Louis Exposition in 1904. Currently, this panorama painting is housed in the Hermitage Museum in St. Petersburg.\*2

panoramic expression to film, which at the time was used only in painting. A massive circular theater with a 360-degree screen was prepared, and in the center, seats mimicking a hot air balloon and gondola were placed. The audience would board this balloon and enjoy the images of a balloon journey surrounding them. The scenery projected in all directions by ten projectors was filled with a sense of presence, and it’s said that there were numerous spectators who could not remain standing due to the immersive experience.

The second was “The Journey on the Trans-Siberian Railway” exhibited in the Russian Pavilion. This, too, offered an experience of enjoying a panorama from inside a vehicle. The audience would sit in a luxurious train installed within the pavilion, appreciating the view from the windows. The panoramic scenery, made up of multiple layers, scrolled mechanically. By having the foreground, middle ground, and background move at different speeds the audience could enjoy a sense of speed as if they were actually traveling on the Trans-Siberian Railway.

Even before the Paris 1900 Expo, the inventions of “cinema” and “panorama” were already known. By combining these, a new technology was born, which enabled the realization of “Cinéorama” and “The Journey on the Trans-Siberian Railway”. These spectacles were fitting for the dawn of the 20th century, later to be referred to as the “Century of Imagery”. A century has passed since that exposition. The immersive VR imagery that we can easily enjoy today may very well be the vision that Grimoin-Sanson once envisioned.

## Enchanted Scenery | Projection Mapping

From spectacular, we can read the signs of future. Now, let us delve into examples of modern-day spectacles and the technology behind.

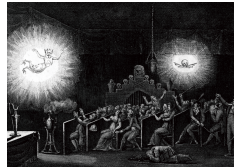
The origins of illumination can be traced back to the early 16th century. It is believed to have begun when Martin Luther decorated the branches of a tree with candles. Desire to illuminate the night with light remains unchanged from then till now.

In the last decade or so, projection mapping has become a notable spectacle. Tracing its history, we land on the “Phantasmagoria”, a horror show that emerged at the end of the 18th century. Ghosts were projected to the audience from hidden locations utilizing a “magic lantern”, the ancestor of projector. Efforts were even made to enhance the ghostly effect by projecting images onto translucent sheets or smoke. It is said the show has been exceptionally popular in Paris.

The technique of projecting images onto translucent screens or smoke is still widely used today and is evident in Hatsune Miku’s live performances or the attractions at Disneyland. Additionally, this principle is employed in AR (Augmented Reality) glasses. A notable example is Microsoft HoloLens. When the glasses are worn, objects appear on a transparent screen in front of the eyes. Users can simultaneously see the objects displayed on the AR glasses screen and the scenery beyond.

200 years since the advent of Phantasmagoria, projection mapping entertains many people. What

Martin Luther, moved by the sight of stars shining brightly in the forest on his way home from the Christmas Eve service, decided to recreate the scene by decorating the branches of a tree with numerous candles.



Using a desolate monastery as the stage, and decorating tombstones, the organizers devoted themselves to creating a meticulously planned atmosphere. A variety of effects were used, such as attaching wheels to the projector to move and change the size of the images and rapidly moving the slide glasses to create the illusion of moving images. \*3



While tech giants are developing AR glasses, a company called Nreal has been gaining recognition in recent years. The features of Nreal’s AR glasses lie in their lightweight design that fits into everyday life, being almost indistinguishable from regular glasses. \*4



Various discrepancies arise due to differences in installation conditions and equipment settings. Furthermore, it’s also crucial to rectify the individual differences each product has from the manufacturing process. Specialized functions are required for calibration and mapping, hence many dedicated software and plugins to cater to these needs have emerged. MadMapper is notably recognized in this realm. \*5

This technique digitalizes the three-dimensional shape of objects. While there are various methods, the barrier to utilization has significantly lowered in recent years with the introduction of sensors in smartphones that are capable of 3D scanning. Another example of a method for obtaining three-dimensional shapes through scanning is a technique called photogrammetry, which utilizes photographs for this purpose.

makes this unique is not merely the “projection” but the “mapping” aspect of it. Instead of projecting onto flat surfaces, it projects onto surfaces like buildings, people, or forests, covering (mapping) the surface with imagery. While the idea itself is simple, there are various technical challenges to enhance the quality.

For instance, as the size of the target increases, many high-luminance and high-resolution projectors are needed. In 2012, a large-scale projection was made onto the Tokyo Station building. It is said that 46 projectors were used in this event. When projecting a continuous image with multiple projectors, calibration technique to adjust the overlapping images is essential. It involves calculating the differing distortions from each projector and lens, aiming to seamlessly blend them together into a unified image.

Since the 2000s, projection mapping has rapidly become popular. The boom was driven by the “maturity of technology” and the “accumulation of knowledge in production”. The brightness and resolution of projectors improved, software for calibration was developed, 3D scanning technology emerged allowing for accurate projection on target objects, and high-speed cameras and image analysis that accurately capture motion became widespread. Moreover, the techniques to effectively incorporate these technologies into show also advanced. It was not just one element, but thanks to the progress in multiple components, projection mapping truly blossomed.

## Major References:

『ギリシア紀』Volume 7, Chapter 24, authored by Pausanias, translated by Kunito Iio, Ryukei Shosha, 1991  
 『漢字の起源』Akiyasu Toudou, Kodansha, 2006  
 『映像機械学序説』Page 128, Masaki Matsushita, Seikyūsha, 1991  
 “Selling Siberia: Russian Railway Panoramas at the 1900 Exposition Universelle”, Tyson Luneau, updated September 17, 2021, accessed March 8, 2022  
<https://www.peripheralhistories.co.uk/post/selling-siberia-russian-railway-panoramas-at-the-1900-exposition-universelle>  
 『イルミネーション検定公式テキスト 2級・3級』Page 6, General incorporated association YAKEI Convention & Visitors Bureau, 2017  
 『マジック・ランタン 光と影の映像史展 図録』Tokyo Photographic Art Museum, Seikyusha, 2018  
 “【TOKYO】初音ミク「マジカルミライ 2022」ライブ映像”, HatsuneMiku, accessed on March 8, 2022  
<https://www.youtube.com/watch?v=cREPk8ttr0o>  
 “東京ディズニーランド新アトラクション「美女と野獣“魔法のものがたり”」本編ノーカットフルバージョン”, accessed on DvideoZ, March 8, 2022  
<https://www.youtube.com/watch?v=C3wKM769seU&t=708s>  
 “プロジェクションマッピングイベントにブームの火をつけた「TOKYO STATION VISION」の裏側を探る”, PRO NEWS accessed on March 8, 2022  
<https://jp.pronews.com/column/20141024110016511.html>

## Image Sources:

\*1 “Cineorama”, Wikipedia, the free encyclopedia, accessed 8 March 2022  
<https://en.wikipedia.org/wiki/Cin%C3%A9orama>  
 \*2 “Category:Trans-Siberian railway in Paris(1900)”, Wikimedia Commons, accessed March 8, 2022  
[https://commons.wikimedia.org/wiki/Category:Trans-Siberian\\_railway\\_exhibition\\_in\\_Paris\\_\(1900\)](https://commons.wikimedia.org/wiki/Category:Trans-Siberian_railway_exhibition_in_Paris_(1900))  
 \*3 “Phantasmagoria”, Wikipedia, the free encyclopedia, accessed March 8, 2022  
<https://en.wikipedia.org/wiki/Phantasmagoria>  
 \*4 “Nreal Air”, Nreal, accessed March 8, 2022  
<https://www.nreal.ai/air/>  
 \*5 “MadMapper”, MapMapper, accessed March 8, 2022  
<https://madmapper.com>

You can refer to this collection of references, including the sources introduced in “From Aurora to Projection Mapping”, as well as related examples that could not be fully covered in the print edition, via the 2D code on the right.



Projection mapping technology significantly gained popularity with the convergence of various technologies and accumulated know-how. Recently, in the context of spectacular representation, there's been a trend following this technology. It's a display similar to “Robot Mass Games”, where a large number of devices are controlled simultaneously.

## Sky as a Display | Drone Shows

With the advancements in communication technology and the proliferation of microcontrollers, the hurdle of “controlling many machines simultaneously” has been lowered. As a result, drone shows are now in the spotlight.

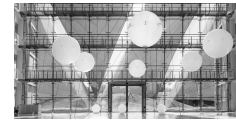
As of May 2021, the drone show that held the Guinness World Record was the one performed in Shanghai for promoting the luxury car brand Hyundai Genesis. 3,281 drones were used to depict the brand logo and other things like a 3D image of a car and a 2D code. The night sky was transformed into a giant display.

However, this world record was broken in just two months. During an event commemorating the 100th anniversary of the Chinese Communist Party, 5,200 drones adorned the night sky of Shenzhen city. This anecdote indicates the rapid and robust growth within the drone industry.

Similar to projection mapping, the advancement of drone shows is also supported by technological evolution across multiple domains. Firstly, the evolution of motors. The widespread adoption of small, inexpensive, and low-maintenance brushless motors has reduced the management cost of drones. Next, motion sensors have become more precise and compact. Also, batteries have seen significant advancements. The miniaturization and increased capacity of LiPo (lithium-ion polymer) batteries now allow for extended drone operations. Lastly, the development of digital technologies capable of controlling these various elements has enabled us to

A type of integrated circuit prioritized for its cost-effectiveness and compact size. Broadly, it can also refer to hardware equipped with integrated circuits that have limited functionality, performance, and purpose compared to typical computers, like the “Arduino” for example. They serve as the brains for many household electronic products.

In recent years, the advancement of components known as MEMS has led to the increased precision and miniaturization of motion sensors. MEMS, which stands for “Micro Electro Mechanical Systems”, are used in sensors to mechanically detect physical quantity.



Defining the term “autonomous” can be challenging. In the case of drones, the control of posture and position is concluded within the aircraft, appearing microscopically autonomous. However, the high-level control that decides the placement and paths of each drone is centrally managed, making it semi-autonomous when viewed macroscopically. The eMotionSpheres mentioned in the text are designed interweaving these two aspects of control. \*1

freely decorate the night sky.

The spectacle of mass control is not confined to drones. Let’s introduce a couple of other examples that dynamically orchestrate the airspace.

First up is the case of “semi-autonomous floating balls”. Festo, a pioneer in pneumatic equipment and electric actuators, developed objects called eMotionSpheres that can fly semi-autonomously indoors. These are large translucent balls fitted with propellers, drifting up, down, left, and right within a room. Ten cameras installed in the room detect the individual positions of the balls using infrared markers and transmit this information to a central computer. The computer, based on the received positional data, calculates the “next movement”, and sends it to the balls. Each ball can also make situational judgments. For instance, if one ball shows unpredictable movement, the other balls can assess and react accordingly, ensuring a system in which collision accidents do not occur.



This installation was created in 2008 and has achieved an award in the Art Division of the Japan Media Arts Festival. ART+COM is a studio established in 1998, with studios in Köln and Berlin. \*2

Next up is an installation involving a multitude of balls suspended from the ceiling titled “The Shapes of Things to Come”. This piece was crafted by ART+COM. Within a 6m<sup>2</sup> exhibit area, 714 metallic balls are suspended from the ceiling, undulating like waves of silver, forming various shapes as they move. Although not possessing a level of freedom akin to drones, the control established by the fishing line enables the assembly of 714 balls to reach a level of completion, as if they all share a single will.

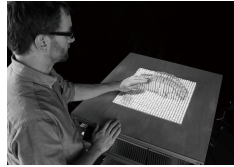


## Touchable Pixels

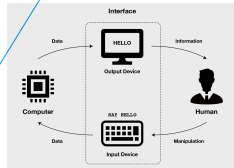
The difference between human mass games and robot mass games lies in “precision”. No matter how extensive the movement patterns become, as long as the calculations are correct, a flawless performance can be realized. It’s not just about pre-programmed movements; interactive expressions that react to inputs or environmental changes are also possible.

For instance, the MIT Media Lab introduced a “tangible 3D display” named “inForm”. It is composed of 900 pins laid out in a grid, where each pin instantaneously changes its height based on the input data or user interaction. The Tangible Media Group, which developed this display, advocates a concept called “Radical Atoms”. The information displayed on a computer screen is comprised of manipulable and free elements, “pixels”. On the other hand, physical objects are constructed of elements with less freedom, called “atoms”. Hence, they propose that if the concept of manipulable atoms, termed “Radical Atoms”, can be physically realized like pixels, it could pave the way for a new human-machine interface.

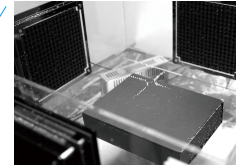
Another interface that closely aligns with the idea of Radical Atoms is the work titled “Pixie Dust” by Yoichi Ochiai in 2017. It is a media art piece that controls pixels in mid-air. The dust-like pixels, levitated by ultrasonic waves, move freely and gradually take shape, opening a possibility for a new display format that seamlessly blends in to nature.



Developed as a new UI using dynamic affordances such as shape change and tactile feedback, it was unveiled in 2013. It’s envisioned for use in simulations during surgery, displaying geospatial data, 3D printing without waste material, and actuators to move tabletop objects remotely.\*3



A user interface (UI) used for bilateral interaction between humans and machines, abbreviated as HMI. Humans issue commands to machines using buttons, handles, computer mouse, etc., and machines inform humans of the outcomes using visuals, sounds, and tactile sensations. It’s also referred to as Man-Machine Interface (MMI).



The core technology of Pixie Dust, an ultrasonic array or what is called a super-directional speaker, is relatively popular as an electronic component. However, the novel approach here is the extensive and individualized control of these components, enabling imaging in midair.\*4



With a diameter of 33mm, each body comes with a motor that can output in 255 levels, and they can communicate with each other up to a distance of 7cm. Hundreds of them can be controlled at once by a controller. Potential future uses include searching for survivors in rubble, creating simple support structures in collapsed buildings, environmental monitoring and pollutant removal, and aiding bee pollination. Manufacturing and sales are handled by K-Team.\*5

Lastly, we would like to bring up an approach where “each small robot makes decisions on the spot”. Harvard University introduced swarm robots known as Kilobots. In this swarm consisting of 1,024 robots, each one operates and communicates autonomously. Through the use of metal plates for wireless charging and infrared communication for fast manipulation, it has become possible to manage a vast number of robots. The behavior model of these swarm robots fundamentally mirrors the ways creatures in nature act as groups. For example, in the case of fish, they are organized by simple rules like “stay close to the fish in front” and “face the direction of the nearest fish”. Similarly, with Kilobots, they follow basic rules while measuring the distance to the robots at the edges or to robots nearby. A unique aspect of such autonomous swarm robots is that they can recover, even if “one or two crash”. A failed unit might not be able to get up, but as a swarm, they can still function without a problem. This presents an organic spectacle, different from a world perfectly orchestrated by centralized control.

From drone shows that “maneuver many machines simultaneously”, to multiple balls “semi-autonomously floating”, and to swarm robots where “many machines move autonomously”, we have introduced new spectacular expressions unique to the modern era where it’s become possible to control thousands of machines. In the next chapter, let’s look towards the future that the spectacle indicates, while also considering examples in virtual spaces.

## Major References:

“ヒュンダイの高級車「ジェネシス」、夜空を彩る 3,281 機のドローンでギネス世界記録を更新”, Real Sound Tech, accessed March 8, 2022  
<https://realsound.jp/tech/2021/04/post-736351.html>  
 “深センのドローンショーでギネス記録更新：5,200 機のドローンで中国共産党 100 周年記念ショー”, SHEN ZHEN FAN, accessed March 8, 2022  
<https://www.shenzhen-fan.com/news-2021-06-world-record-5200-drone-show-in-sz/>  
 “Drone 100: A World Record with 100 Points”, ARS ELECTRONICA, accessed March 8, 2022  
<https://ars.electronica.art/aeblog/ja/2016/01/12/drone100/>  
 “eMotionSpheres”, Festo, accessed March 8, 2022  
[https://www.festo.com/lt/en/e/about-festo/research-and-development/bionic-learning-network/highlights-from-2013-to-2014/emotionspheres-id\\_33514/](https://www.festo.com/lt/en/e/about-festo/research-and-development/bionic-learning-network/highlights-from-2013-to-2014/emotionspheres-id_33514/)  
 “KINETIC SCULPTURE — THE SHAPES OF THINGS TO COME, 2008”, ART+COM Studios, accessed March 8, 2022  
<https://artcom.de/en/?project=kinetic-sculpture>  
 “inFORM”, Tangible Media Group, accessed March 8, 2022  
<https://tangible.media.mit.edu/project/inform/>  
 “A Thousand Kilobots Self-Assemble Into Complex Shapes. This is probably the most robots that have ever been in the same place at the same time, ever”, IEEE Spectrum, accessed March 8, 2022  
<https://spectrum.ieee.org/a-thousand-kilobots-self-assemble>

## Image Sources:

\*1 “eMotionSpheres”, Festo, accessed March 8, 2022.  
[https://www.festo.com/lt/en/e/about-festo/research-and-development/bionic-learning-network/highlights-from-2013-to-2014/emotionspheres-id\\_33514/](https://www.festo.com/lt/en/e/about-festo/research-and-development/bionic-learning-network/highlights-from-2013-to-2014/emotionspheres-id_33514/)  
 \*2 “KINETIC SCULPTURE — THE SHAPES OF THINGS TO COME, 2008”, ART+COM Studios, accessed March 8, 2022  
<https://artcom.de/en/?project=kinetic-sculpture>  
 \*3 “inFORM”, Tangible Media Group, accessed March 8, 2022  
<https://tangible.media.mit.edu/project/inform/>  
 \*4 “Pixie Dust”, Yoichi Ochiai Official Portfolio, accessed March 8, 2022  
<https://yoichiochiai.com/art/pixiedust/>  
 \*5 “Kilobots, T-cells and Cancer”, The University of California, San Francisco, accessed March 8, 2022  
<https://www.cgl.ucsf.edu/chimera/data/kilobots-jan2015/cancerbots.html>

You can refer to this collection of references, including the sources introduced in “Mass Games by Robots”, as well as related examples that could not be fully covered in the print edition, via the 2D code on the right.



Since 2020, due to the outbreak of the COVID-19, we have lost many situations where we can “gather together to enjoy spectacles”. So, where have the venues for today’s live performances and theater gone? And what kind of shape does the future hold as seen from the current spectacles?

## Spectacles in the Pandemic Era | Metaverse

Recent improvements in PC and smartphone specs and advances in network technology have broadened the range of experiences in the online space. Furthermore, the impact of COVID-19 has amplified the need for simultaneous experiences in spaces other than physical reality. We are seeking “places to watch together”. Emerging in this demand are simultaneous experiences held in virtual spaces, often referred to as the “metaverse”.

Let's look at an instance of live performances in virtual spaces. In 2020, popular rapper Travis Scott performed in the online game Fortnite, garnering attention as a successful case of virtual live performances. The spectacle leveraged the characteristics of virtual space, such as a gigantic avatar of Travis Scott appearing in the gaming environment.

These shows often incorporate techniques like motion capture or representations resembling projection mapping, both have been commonly used in live performances in the physical realm. While virtual spaces allow for the freedom to design the size of human figures and the shape of stages as desired, virtual live venues are often designed to look “familiar” and “realistic”. This suggests that the experience in virtual spaces might be in a “transitional phase from realism to abstraction”. Much like how interface design transitioned from skeuomorphism to flat design as user receptivity matured, the stylistic expression of virtual live events might also evolve in alignment with this maturation process.



Fortnite is an online game developed and operated by Epic Games. Launched in 2017, it's a massive platform that recorded over 80 million unique monthly users. Various campaigns using different character IPs and online live performances by real individuals have been conducted, serving as a catalyst for lively discussions about the metaverse. \*1



For instance, when designing an icon for a calendar app, a design mimicking the texture and appearance of a real calendar was created, making it easy for the user to understand what it stands for. This is skeuomorphism. However, after 2013, simple designs unique to CG, represented by flat design, have become mainstream. \*2

It doesn't mean everything can be done freely and cheaply. While a real live event may host 100,000 people, a virtual live event where 100,000 avatars gather is not achievable with current network and device capabilities. Moreover, the minimum cost is higher compared to real live events. There are aspects where one can break free from physical constraints, and parts that are bound by different restrictions compared to the real world.



Not limited to Hakkasan Grid, stage lighting operates via a protocol called DMX. In recent years, game engines like Unreal Engine have started to support DMX, increasingly enabling the use of game engines as simulators for lighting productions. \*3

Various spectacle expressions, experimented with before the COVID-19, have flowed into the metaverse since around the year 2020. It's as if we have obtained a new “testing ground” where expressions can be pursued disregarding physical conditions and costs. Hosting live events in the metaverse space is gaining attention as a new business due to reduced operational costs and the ability to overcome the physical limitations of participants. Various services have emerged, such as the VR music platform Wave, the virtual live-capable application VARK and so on. This trend can be perceived as a prototype for real-world spectacles. Once the period of staying indoors ends, we will soon go back to real live venues. At that time, the spectacles matured within the metaverse may flow back into physical space. Expressions from the pixelated world will be implemented in the physical world. It will be the advent of the world envisioned by the concept of Radical Atoms.

In fact, “experiencing reality as if it were a virtual space” has already begun. WHITEvoid Studio created the robotic lighting Hakkasan Grid in 2019. This installation, crafted for a Las Vegas nightclub, stands as the largest kinetic light installation in the US. The roughly 1.2m triangular lights move together to form various patterns. The dynamism and unity of Hakkasan Grid, which alters its color and shape in tune with live music, is likely to be a pioneer in extending the excitement we currently feel in the metaverse to the physical realm.



## Reflecting on the Future through Spectacles

Spectacles have been utilized as symbols of power, or as evidence of affluence. Over time, they become socially implemented, turning into part of our daily lives. Based on the spectacles of now, what kind of future can we imagine?

As technology advances, the sort of mechanisms we've seen so far are likely to be incorporated into permanent environments. Not only temporary shows, but implementations on the time scale and magnitude akin to architecture could take place.

For instance, the societal implementation of drone and robotics technology is already underway, albeit unseen. In 2012, Amazon acquired the robot company Kiva Systems. The autonomous transport robots developed based on Kiva's technology have been introduced in Amazon warehouses worldwide. Instead of humans walking around the warehouses, a system is in place where goods shelves mounted on robots move inside warehouses swiftly, facilitating the speedy shipping of products.

Expanding the "goods move, not people" system to the scale of a city connects with the concept of e-Palette, a low-speed self-driving vehicle that TOYOTA announced at CES 2018. Having these vehicles moving autonomously within in the city with stores and the goods, people's lives will undergo drastic transformation.

Radical Atoms suggested a future vision for the interface between computers and humans. And the idea of "moving goods and services" suggests a state



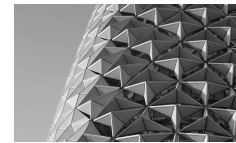
The introduction of autonomous transport robots as the main actors in moving goods has significantly altered the inside of warehouses. For example, the arrangement of items within a warehouse has changed. In the past, a more organized display based on item types was common, but now arrangements like free location or chaos storage, which prioritize efficiency despite appearing disorganized, are becoming mainstream. \*4



Apart from e-Palette, TOYOTA has been engaging in advanced proposals and experiments. However, the innovations toward mobility are tied to urban planning, which posed a challenge for conducting large-scale practical demonstrations. The Woven City announced by TOYOTA at CES 2020 aims to create a city as a gigantic experimental field, with preparations moving forward accordingly. \*5

in which the computer itself is integrated within the environment, and the environment itself is the interface. Houses and towns might become like creatures that metamorphose in response to their environment. There are signs of this already, in houses that transform to ensure sunlight exposure, and buildings with walls that open and close to ventilation.

The Al Bahr Towers in Abu Dhabi are enveloped in a mechanical facade inspired by traditional geometric patterns. This facade is designed to automatically open and close based on wind speed and sunlight data measured by sensors attached to the building, to maximize indoor comfort. The way the facade opens is reminiscent of how a pinecone opens as it matures.



The 29-story, 145m tall twin towers built in the Emirate of Abu Dhabi were designed by the British firm AHR. \*6

These examples may sound like science fiction. However, considering the current scenario driven by both software and hardware evolution, these are not unrealistic at all. If we regard the various spectacles introduced so far as "prototypes of the future", the landscape of the future will be one in which humans and the environment resonate.

When photography was invented, the captured scenes were so precise that many people felt like they were looking at real landscapes. Now, when we come across beautiful scenery, we describe it as looking "like a photograph", a curious reversal. Similarly, a future in which we live in a "metaverse-like" reality is approaching, and we may face its arrival at the boundary between virtual and real space.

## Major References:

"Travis Scott and Fortnite Present: Astronomical (Full Event Video)", Travis Scott, accessed March 8, 2022  
<https://www.youtube.com/watch?v=wYeFAMC8qU>  
 "HAKKASAN NIGHTCLUB REINVIGORATES THE NIGHTLIFE EXPERIENCE WITH IMMERSIVE HAKKASAN GRID",  
 HAKKASAN NIGHTCLUB, accessed March 8, 2022  
<https://hakkasannightclub.com/blog/hakkasan-grid-unveiling-edcweek/>  
 "What's it like to work with robots at an Amazon fulfillment center?", Inside Amazon Videos, accessed March 8, 2022  
<https://www.youtube.com/watch?v=cn86KkPNYjk>  
 "e-Palette | Toyota", Toyota Global, accessed March 8, 2022  
<https://www.youtube.com/watch?v=L4WqSKpGk>  
 "AL BAHAR TOWERS", AHR, accessed March 8, 2022  
<https://www.ahr.co.uk/projects>  
 "The Camera; Life library of photography", The editors of Time-Life Books, Time Life UK, 1970

## Image Sources:

\*1 "Fortnite | Free-to-Play Cross-Platform Game – Fortnite", Epic Games, accessed March 8, 2022  
<https://www.epicgames.com/fortnite/>  
 \*2 "Check Out This Documentary on Apple's Skeuomorphic Era of Design [VIDEO]", Usman Qureshi, accessed March 8, 2022  
<https://applephoneshow.com/check-out-this-documentary-on-apples-skeuomorphic-era-of-design-video/>  
 \*3 "The Hakkasan Grid Now In Circuit", HAKKASAN NIGHTCLUB, accessed March 8, 2022  
<https://hakkasannightclub.com/blog/hakkasan-grid-now-circuit/>  
 \*4 "Amazon Robotics が、Amazon SageMaker、および AWS Inferentia を使用して大規模な機械学習推論を実現", Amazon, accessed March 8, 2022  
<https://aws.amazon.com/jp/solutions/case-studies/amazon-robotics-case-study/>  
 \*5 "e-Palette | Toyota", Toyota Global, accessed March 8, 2022  
<https://www.youtube.com/watch?v=L4WqSKpGk>  
 \*6 "AL BAHAR TOWERS", AHR, accessed March 8, 2022  
<https://www.ahr.co.uk/projects>

You can refer to this collection of references, including the sources introduced in "The Present and Future of Spectacle", as well as related examples that could not be fully covered in the print edition, via the 2D code on the right.

**Commentary: Metaverse** By: Kosei Ikeda

"Metaverse" refers to a fictional service that provides virtual 3D space. It first appeared in Neal Stephenson's science fiction novel "Snow Crash," published in 1993. Nowadays, the term is used more broadly to refer to similar services or spaces.

There are currently various types of services referred to as metaverse. Services like "Second Life" and "VRChat" do not have a specific goal; their purpose is to bring people together. On the other hand, other services like "Minecraft" and "Fortnite" have the purpose of being games.

In both types of service, people gather, and relationships are formed. However, the nature of relationships in Meta's (formerly Facebook) social graph, which is being developed and will likely be integrated into the metaverse in the future, is different from the relationships in game-based metaverses like the ones mentioned earlier. These differences will become significant as the services evolve, potentially becoming as important as, or even more important than, the initial purpose of the service itself, shaping their existence.

The concept of the metaverse isn't entirely new. However, the current signs of popularity are under different circumstances compared to before. The global internet connectivity allowing many people to connect, network speeds for seamless action, and processor capabilities for rendering people and spaces in 3D in real-time, have improved. However, it's still not enough; the necessary technological advancements may be further propelled by the influx of capital and human resources into the metaverse.

The theme of this issue is spectacle, and it discusses a future vision where spectacle, which was a temporary existence and a kind of celebration, becomes a permanent part of everyday life, blending seamlessly into our daily routine. The current metaverse is still in development, with a strong aspect of being a venue for temporary activities like gaming, shopping, or meetings. Yet, the direction in which the metaverse is heading is to a space where we eventually spend more time and execute more actions, and this change will be driven by a gradual shift in the mental models, values, and societal structure of the participants influenced by preceding technological innovations.

## Commentary: Radical Atoms *By: Toyoshi Morioka*

Radical Atoms is a vision put forth in 2009 by the Tangible Media Group at MIT (the Massachusetts Institute of Technology). They are engaged in what's called Vision-Driven Design Research, studying potential products of an envisioned future.

Traditional interfaces (Graphical User Interfaces) are confined to the digital realm under a display, where humans cannot physically interact with them.

Therefore, they created a vision of TUI (Tangible User Interface), which embodies digital information in the physical world, and introduced musicBottles. musicBottles links music data to glass bottles, constructing a new interface that allows music to play simply by opening the lid of the bottle.

However, they recognized a problem with TUI. In the case of musicBottles, music data can be played from any location effortlessly, but controlling the shape of the bottle linked to the music data inside is challenging. In other words, it is difficult for physical objects to respond to dynamic changes in digital data. This led to the conceptualization of Radical Atoms. As the name suggests, this concept envisioned minuscule entities like atoms changing shape in accordance with digital alterations, while enabling interaction between the digital and physical realms.

A prototype embodying the concept of Radical Atoms called "inFORM" was created where a computer can move a large number of cubes, allowing objects placed on inFORM to be lifted or moved.

Research and development based on concepts similar to the proposed Radical Atoms seem to be on the rise in recent years. It might be intriguing to revisit the references in this issue from the perspective of Radical Atoms.

## THE TECHNOLOGY REPORT\_

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Spectacle

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## Editors' Dialogue

### —Any recent “spectacles” you've witnessed?

- Tsuchiya** I attended an event called “Dondo Yaki”, where New Year decorations, amulets, and talismans are burned. The moment the fire was ignited, the flames rose to an incredible height which was scary, but also partly exciting. I thought this must be what a “spectacle” essentially feels like.
- Izumida** The other day, there was incessant lightning in the northeastern sky. The intensity was apocalyptic, inducing a certain fear, yet I found myself unconsciously pulling out my smartphone. It made me wonder, perhaps humans are quite oblivious when it comes to threats.
- Nakano** Perhaps a spectacle is about observing “uncontrollable dangers” from a “safe distance”.
- Ikeda** Despite knowing the “danger”, people tend to go to watch rivers flooding or waves during a typhoon. Such acts may also be about “succumbing to the allure of spectacle”.
- Izumida** When I saw Fujiko Nakaya’s “Fog Sculpture”, I thought, “Ah, this is a spectacle”. Within a few minutes of the mist being emitted, it turned into a massive cloud, and eventually, everyone was engulfed in the fog. It was quite an experience.
- Shimizu** A few years ago, I witnessed a total solar eclipse in the United States. A total solar eclipse is not merely about darkness, but also the slight coolness you feel on your skin, the quieting of bird chirps. It felt like a spectacle experienced with the entire body within the whole space. I realized it’s quite remarkable to experience something as a “whole”.

### —What spectacle is likely to be implemented in society in the near future and become part of everyday life?

- Nakano** It might become commonplace to see our blue planet, Earth, in the near future. According to the founders of a US company called Space Perspective, they plan to offer the experience of “ascending to the stratosphere in a hot air balloon to gaze upon the Earth” by the year after next.
- Tsuchiya** I have a hunch that immersive experiences without a head-mounted display will become a daily occurrence. With the decreasing costs of depth sensors and the advent of high-luminance projectors, it might become more commonplace than it is now.
- Morioka** A world where information overlays what we see, like AR, also seems likely to become integrated into our daily lives soon. There is already research into displays that project directly onto the retina.
- Shimizu** There are already examples implemented in theme park attractions, but I feel the idea of transforming train or bicycle windows into LED screens to create fantasy spaces or galactic scenes as if traveling through different realms will expand more as autonomous driving becomes established.
- Izumida** Speaking of autonomous driving, “platooning” comes to mind. The technology uses LiDAR sensors to avoid walls and obstacles while moving within an attraction in a formation. If all autonomous vehicles adopt “platooning” in the future, the experience of riding itself may become more entertaining.
- Ikeda** I believe that architecture will also become a new spectacle. There’s already “kinetic architecture” where the shapes of buildings physically change. For example, I dream about creating a “dynamic city” by gathering such buildings where the city itself transforms, or further expanding this idea to create a “dynamic landscape” where the terrain itself changes...

## —Events where you felt a new sense of “Spectacle”?

- Tsuchiya** When influencers upload new videos and get a lot of “likes” or gain subscribers almost instantaneously, it seems that the process of “numbers skyrocketing” itself is already a spectacle. It feels new that many people share a rush of adrenaline from the mere rise and fall of numbers.
- Nakano** That’s right, YouTube’s Super Chat is similar. Crowdfunding too, I think it’s a system that utilizes the spectacle of numbers in addition to the story.
- Shimizu** In the United States, the casual stock trading app Robinhood has become very popular. Users encourage each other to “raise the price of this stock a lot”, and enjoy seeing a stock price increase tenfold in a day. When you actually participate, it’s so thrilling that it’s hard to focus on work.
- Ikeda** The experience of uniting to accomplish something big, especially in our increasingly complex modern society, must evoke positive emotions. Accomplishing something beyond the capability of an individual, and finding it enjoyable, meaningful, and significant. Such a system could be the ideal, influencing reality.
- Tsuchiya** It’s not a pleasant analogy, but I sometimes think that backlash might be the most contemporary of spectacles.
- Nakano** Spectacles have both positive and negative aspects. In mythology, disasters and miracles are spectacles, that’s why they are passed down. In that sense, the recent pandemic is a kind of spectacle too.
- Shimizu** The other day, I had a medical checkup for the first time. During an MRI, you’re in a tight space, with your vision obstructed, and you have to listen to the noise of the machine continuously. It was kind of like, “Is this the afterlife?” It was really scary but fascinating. There might be a spectacle in this “sensory deprivation”, too.

- Tsuchiya** Being in a place where information is cut off has now, conversely, become a new sensation.
- Ikeda** We have perceived spectacle as something external, environmental, but the transformation of oneself might also be an ultimate spectacle.
- Morioka** At the 2019 Aichi Triennale, I felt a new sense of spectacle in Dividual inc.’s “Last Words / Type Trace”. It’s a piece that displays many last words collected on the Web, but it included information like “erase” and “rewrite,” making it more than just arranged letters—I could feel the presence and emotions of people.
- Izumida** It’s not about a particular event, but the way a technological development now presents itself like an ordinary thing brings me both astonishment and a kind of fear. Images from Mars sent by NASA’s rover are casually uploaded on YouTube and Twitter, to be consumed alongside other daily content. When I stop and think, I realize, “This footage is from uncharted lands for humankind, if you think about it!”

\*This discussion was held in January 2022.

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