THE CANON FRONTIER 2021/2022

Focus on Technology and R&D

Building the Future by Fusing Imaging Technology and Cutting-edge Technology

**Canon's technology, with its origins in camera development,
is now expanding its possibilities and being applied to wide-ranging fields
from security to commercial printing, medical treatment and industrial equipment.
All in order to solve diverse social challenges and enrich lives.
By joining imaging technology with AI, cloud and other IT,
Canon is unlocking the next stage of the future.**

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Building the Future through Innovation

Executive Vice President & CTO, Canon Inc.
Toshio Homma

Amidst the ‘new normal’ forced upon us by the COVID-19 pandemic,
and during a time of tumultuous change around the world,
how will Canon develop technologies and contribute to mankind and society?
Toshio Homma, Executive Vice President and CTO (Chief Technical Officer),
talks about research and development at Canon.

A Period of Change for Canon and the World

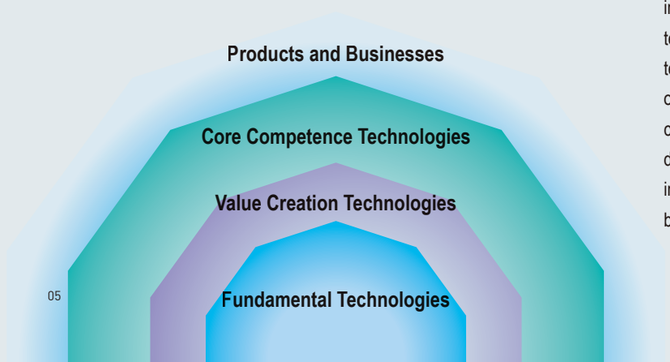
— Canon’s Current State of R&D and View of Society —

As society changes dramatically due to the digital transformation (DX), which is itself accelerating in terms of the shift to a new normal, Canon is also approaching a major turning point. Alongside the continued contraction of markets for cameras and other products that once constituted our core businesses, significant changes are affecting the office multifunction device and printer markets as well. We are taking on the challenge of great transformation in order to reach the next stage of growth.

With technology at the heart of global transformation, research and development, which has thus far been invention-focused, now also becomes innovation-focused so that it may help solve social challenges, thus experiencing a paradigm shift.

R&D in ages of industrial society and information society has involved finding the seeds of technology and bringing forth a proliferation of carefully-nurtured inventions. Groundbreaking products have been launched one after the other, enriching our lives, improving convenience and changing the world. Yet now, the march of globalization is seeing the emergence of numerous social issues and the rise of technologies to address them. Indeed, we live in an age when social issues are necessitating technologies, one when efficient R&D requires more than just cultivating seeds through "invention-focused" R&D. For its part, Canon is engaging in M&A and other endeavors to create innovations with immediate effectiveness and speeding up innovation-focused R&D which rapidly addresses social problems.

Seizing this opportunity, Canon is pivoting towards open innovation through industry-academia partnerships in our invention-focused R&D, while, in our innovation-focused R&D, we are refining our own technologies and incorporating additions gained through such means as alliances with other companies and M&A. In this way, we are accelerating R&D that generates innovation capable of precisely meeting social needs.



Creating Businesses by Combining Fundamental Technologies with Core Competence Technologies

— The Basic Concept Behind Canon's R&D —

Since its founding, Canon has been distinguishing between its highly versatile platform technologies that form the foundation of its businesses and the core technologies that directly support its businesses, providing a diverse range of products and services by combining these technologies in a variety of ways. And our five-pillar portfolio of existing businesses — cameras, office multifunction devices, inkjet printers, laser printers, and optical equipment — is no exception. At the same time, for our four-pillar portfolio of new businesses consisting of medical systems, network cameras, commercial printing, and industrial equipment, we have been strengthening competitiveness by incorporating our long-held fundamental technologies into the core technologies that have recently become part of the Canon group.

We have transformed several of these core technologies into platform technologies through repeated R&D efforts. Toners and other advanced materials, for example, were once core technologies used in copying machines. Now they are platform technologies such as powder synthesis technologies or chemical reaction analysis technologies, which are proving useful in developing competitive products for other businesses. In our imaging businesses, one of Canon's major strengths, our high-resolution processing technologies and our lens, sensor, and other imaging device technologies — our overwhelmingly superior core technologies — are making Canon cameras more competitive. These technologies are used in other businesses as platform technologies for our optical, semiconductor and information processing technologies. The core technology behind Canon camera face detection has been further developed as a fundamental technology for detection AI and is now being incorporated into healthcare IT systems helping to diversify our medical business.

The features of Canon’s R&D are not limited to this alone. The technology and know-how that Canon has accumulated during its growth supports the quality, cost, and on-time delivery of our brand. We are incorporating this as value creation technology in our core competence management. Robust value creation technologies, which focus on intellectual property, quality, design, value engineering, project management and the environment, are one of Canon’s greatest strengths for quickly growing business.

Now more diverse than ever, Canon pursues product development following plans unique to each product division. At the same time, the head office’s development division engages in advanced trend research and technology development. We are implementing core competence management by having divisions and the head office simultaneously engage in multi-layered R&D while still staying very closely coordinated.

Aspiring to Innovate Using a Combination of Cyber and Physical Technologies

— How will Canon's R&D Change? —

A variety of social challenges have become clear as we strive to achieve innovative life styles and work styles in this ‘new normal’ society. Adapting to these historical changes, Canon embarks in 2021 on phase VI of our Excellent Global Corporation Plan. Following this plan, we will strengthen R&D along three trajectories.

First, we will further strengthen fundamental technologies and value creation technologies. Pushing the evolution of value creation technologies contributes to greater efficiency for existing businesses. At the same time, we will identify the wide-ranging, essential core technologies of group businesses, then enhance their fundamental technologies and channel them into the core technologies of new businesses. This approach to core competence management strives to strengthen existing businesses while fostering new group businesses.

Second, we will generate the seeds of our next ventures based on robust core technologies and fundamental technologies. For example, we will develop new functional materials leveraging functional material technology based on ink and toner materials, while also developing devices leveraging other specialized materials, then we will foster next-generation technologies as the seeds of new business. Through technological diversification, we will blaze a trail into new business domains.

Last, we will strengthen innovation-focused technology development that meets the needs of this era. While recognizing trends such as DX and carbon-neutral solutions, we will continue driving technology development that leads to higher corporate value. In particular, Canon is focusing on cyberspace, which allows us to merge myriad services, physical space where people connect with one another and a cyber-physical system that effectively integrates both. We are developing cyber and physical technology that is one step ahead by incorporating advanced cyber technology gained through our partnerships into our world-class core technologies in physical domains.

Supporting the Growth of Technicians through Core Competence Management

— Human Resources to Support Future R&D —

People are the key to these new approaches. People able to dexterously handle both business and technology domains, those who can take on the challenges of unknown fields and people who can boldly strike forth a new era are essential. Canon employees can work with world-class core technologies in our commercial business development and cutting-edge fundamental technologies in our head office’s development division. Through core competence management in both divisions, young employees have opportunities to exercise their talents, while robust on-the-job training allows us to foster human resources with a high level of practical skill. Furthermore, we specify new technology domains to strengthen, then offer training options for mastering that technology in order to cultivate R&D professionals who are well-equipped for the modern age.

What follows is an introduction of examples of Canon’s core competence management, including core technologies used in products, such as nanoimprint lithography, which helps realize miniaturized semiconductors; fundamental technologies, such as AI technology and detection technology, exemplified in cutting-edge SPAD image sensors; and value creation resources, such as virtual prototyping technology, production technology, intellectual property and design.

Applying technological strengths towards greater progress

Latest Image Sensor（SPAD sensor）

Canon Successfully Develops the World's First 1-megapixel SPAD sensor

One of the key components that will change society as we know it is the "sensor," a device that changes light into electronic signals. In June 2020, Canon announced that it had successfully developed the world's first 1-megapixel single photon avalanche diode (SPAD) image sensor, drawing attention from industry watchers all over the world.

Measuring the Value of Light —not the Amount

SPAD sensors are a type of image sensor. The term "image sensor" probably brings to mind the CMOS sensors found in digital cameras, but SPAD sensors operate on different principles.

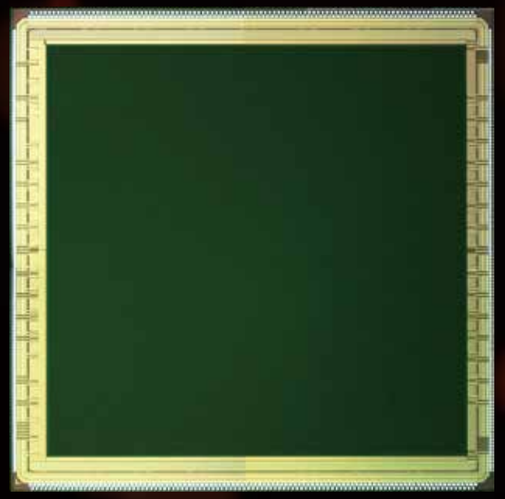
Both SPAD and CMOS sensors make use of the fact that light is made up of particles. However, with CMOS sensors, each pixel measures the amount of light that reaches the pixel within a given time, whereas SPAD sensors measure each individual light particle (i.e., photon) that reaches the pixel. Each photon that enters the pixel immediately gets converted into an electric charge, and the electrons that result are eventually multiplied like an avalanche until they form a large signal charge that can be extracted.

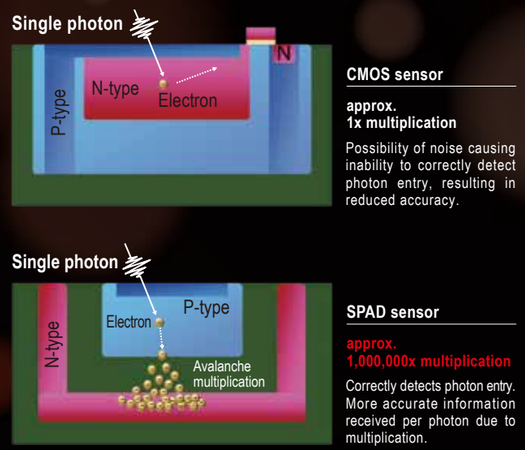
CMOS sensors read light as electric signals by measuring the volume of light that accumulates in a pixel within a certain time frame, which makes it possible for noise to enter the pixel along with the light particles (photons), hence contaminating the information received. Meanwhile, SPAD sensors digitally count individual photon particles, making it hard for electronic noise to enter. This makes it possible to obtain a clear image.

Breaking Through the Pixel Count Ceiling

Until recently, it was considered difficult to create a high-pixel-count SPAD sensor. On each pixel, the sensing site (surface area available for detecting incoming light as signals) was already small. Making the pixels smaller so that more pixels could be incorporated in the image sensor would cause the sensing sites to become even smaller, in turn resulting in very little light entering the sensor, which would also be a big problem.

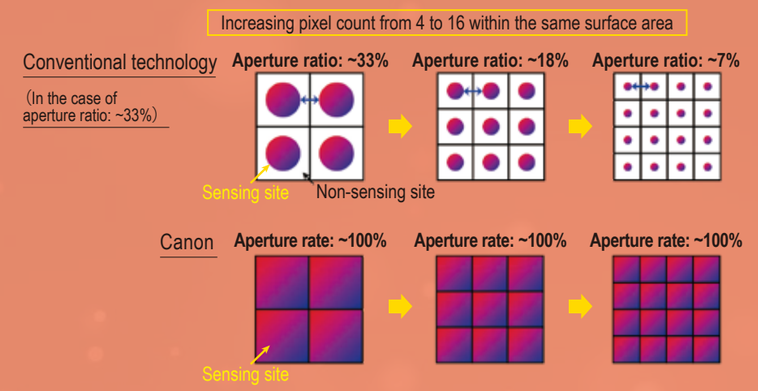
Canon incorporated a proprietary structural design that used technologies cultivated through production of commercial-use CMOS sensors. This design successfully kept the aperture rate at 100% regardless of the pixel size, making it possible to capture all light that entered without any leakage, even if the number of pixels was increased. The result was the achievement of an unprecedented 1,000,000-pixel SPAD sensor.





Comparison of CMOS sensor and SPAD sensor

Technical challenges of SPAD sensors and Canon's advantages



Unprecedented High-speed and High-precision Distance Measurements

The SPAD sensor that Canon developed has a time resolution as precise as 100 picoseconds, which enables extremely fast information processing. This makes possible capture of the movement of objects that move extremely quickly, such as light particles. The sensor can also utilize its "high-speed response" feature to conduct high-precision distance measurements, including three-dimensional distance measurements.

While the Time-of-flight (ToF) method, which involves directing light at a subject and measuring the time taken for it to be reflected back onto the sensor, makes possible precise distance measurements, this method could not be used because the extremely fast speed of light necessitated a light sensor capable of extreme high-speed responsiveness. Canon's SPAD sensor can detect returning light in nanosecond3 units or less, achieving what previous light sensors could not—making ToF measurements a reality.

Enables the Sensor to Capture Slow Motion Videos at a Level of 24,000 Frames per second

The SPAD sensor that Canon has developed is also equipped with a global shutter that can capture videos of fast-moving subjects while keeping their shapes accurate and distortion-free. Unlike the rolling shutter method that exposes by activating a sensor's consecutive rows of pixels one after another, the SPAD sensor controls exposure on all the pixels at the same time, reducing exposure time to as short as 3.8 nanoseconds and achieving an ultra-high frame rate of up to 24,000 frames-per-second (FPS) in 1-bit output. This enables the sensor to capture slow motion videos of phenomena that occur in extremely short time frames and were previously impossible to capture.

Such phenomena include instantaneous natural phenomena or chemical reactions that previously could not be captured accurately, or the damage that occurs to objects when they fall or collide with something else. There are many potential applications for an image sensor that enables the detailed capture of such events, including greater understanding of natural phenomena and assess product safety and durability.

Potential Applications in AR, VR, and Driverless Vehicles

By making distance measurement via the ToF method possible, Canon's SPAD sensor enables ultra-high-speed image capture at a high resolution of 1 megapixel. This facilitates accurate three-dimensional distance measurement, even in complex scenarios where multiple subjects overlap.

In the fields of AR (augmented reality) and VR (virtual reality), which involve superimposing virtual images on top of real ones, being able to use the SPAD sensor to speedily obtain accurate three-dimensional spatial information enables more precise alignment of positions in real time. There are also high expectations for the application of SPAD sensors in solving one of the greatest challenges in designing driverless vehicles: the measurement of distances between a vehicle and the people and objects in its vicinity.

Enriching the Future of Society by Turning Dreams into Reality

The successful development of Canon's 1-megapixel SPAD image sensor also means that 3D cameras capable of recognizing depth information can now do so at a resolution of up to 1 megapixel. One highly anticipated application of this capability is in the high-performance "eyes" of robots and devices that society will rely on in the future.

But before this, it was considered unlikely that a 1-megapixel resolution on a 3D camera could be realistically achieved.

Canon's research and development efforts increase the possibility that yet-unknown services and products that many people would have never dreamt of, yet hold the potential for great impact, may someday become reality.

Volumetric Video System

Offering a Brand-new Viewing Experience

Making it possible to enjoy an immersive field-level viewing experience, Canon's imaging technology offers a cutting-edge way to watch sports and experience the entertainment.

For more information about Volumetric Video Studio

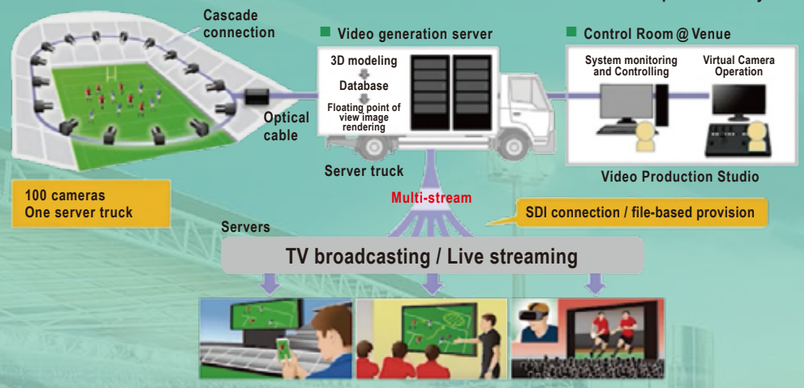
A Revolutionary Technology which Dramatically Changes How Sports are Viewed

Conventional stadium systems use fixed cameras and cable-suspended cameras, which provide video feeds from limited viewpoints. Meanwhile, Canon's Volumetric Video System allows the viewer to see the action on the field from any position or any angle in the stadium. You can view the same scene from various angles, changing to the perspective of an athlete on the field or any number of alternate viewpoints. Additionally, viewers can control both viewpoint and game time at will. For example, viewpoint can be changed while watching the scene in slow motion. This revolutionary technology dramatically changes how sports are viewed, and it has become reality.

The means by which video is generated may very well be considered the future of video capture. Visual data is captured by high-resolution cameras installed around the stadium, then converted into 3D data and stored on servers. When the user sets or moves the position of the virtual camera, the video they see is generated from the 3D data to show video from the desired camera angle. This video data can then be output for viewing.

In addition to optical and visual technologies consistently developed since its founding, the Canon group develops cutting-edge technologies in such fields as network transmission and user interface. Such technologies have the power to take the workflows of video production and broadcasting to a new level. Canon's project to develop its Volumetric Video System involved selecting developers from various divisions to work together and combine their specialized engineering skills.

Example setup and applications of the Free Viewpoint Video System



Maintaining Innovative Spirit for a Greater Height Ushering in a New Era

During World class rugby tournament, Canon provided highlight footage from the Free Viewpoint Video. That footage featured an immersive experience as if viewers were right on the pitch, not possible with conventional cameras, effectively conveying the thrill and superb skill of rugby.

Accurate 3D data from fast-moving sports scenes, every camera must start shooting at the exact same time. If the timing is off for even one camera, the data cannot be generated correctly. Developers were aware of this issue from the design phase, and accordingly developed algorithms to control and completely synchronize the start of shooting for multiple cameras. An additional challenge is the need to process enormous amount of data instantaneously in order to generate Free Viewpoint Video data. Efforts are underway to generate high-definition images at faster speeds through such means as parallel distributed processing.

In addition to sports, Volumetric Video Systems are enabling the creation of completely new content in the field of entertainment. Since it was originally researched and developed for sports, it can produce video even for performances where multiple subjects are present in a wide area. The absence of an actual camera or photographer on stage allows for free camera work without the camera showing up in various cuts.

Canon launched Volumetric Video Studio - Kawasaki, that makes possible a fully supported workflow, including capturing and editing of 3D content in 2020. Using 4K cameras and Canon's proprietary image processing technology, high-detail video and 3D data can be generated almost simultaneously with capturing, enabling live streaming of video and shortening the time required for content production.

Canon will continue to develop technologies that break down the barriers of location and time, leading to the creation of unprecedented value.

Volumetric Video Studio -Kawasaki filming area-

Medical AI

Deep Learning-powered Equipment will Overhaul Healthcare

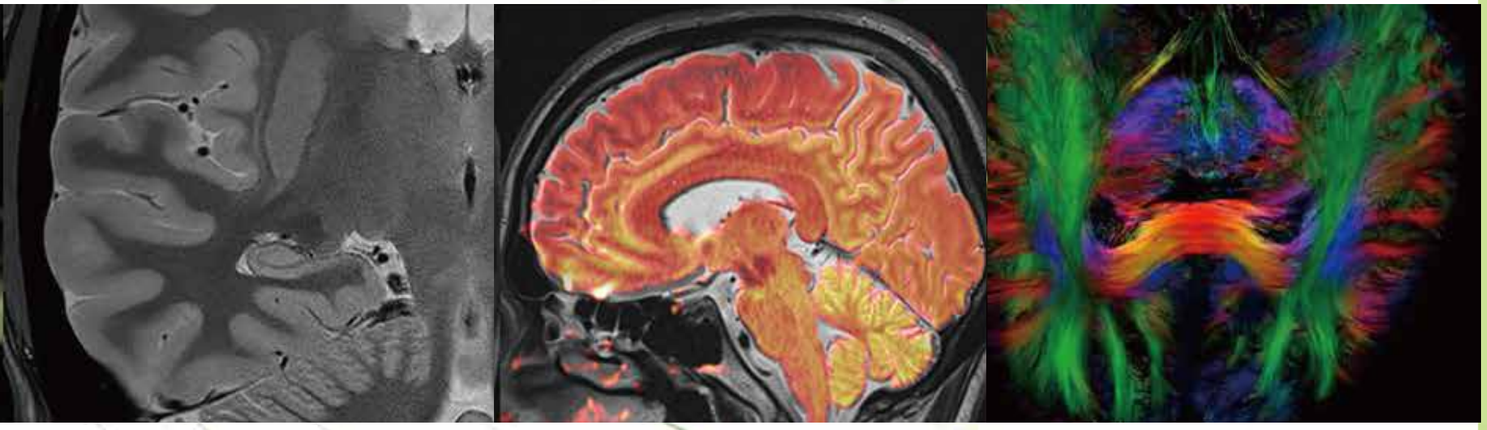
The MRI is becoming more widely used.
At Canon, we have succeeded in employing the latest imaging technology that makes use of deep learning to enhance image quality while shortening examination time, thereby reducing the burden on patients and medical professionals.

The world's first MRI system to be equipped with a deep learning-based noise suppressing reconstruction system

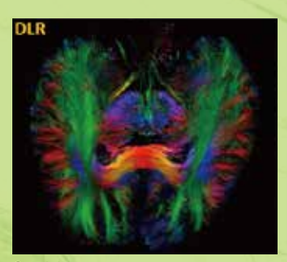
MRI Examination Times Prevent Growing Needs from Being Met

As a diagnostic imaging device for use in medicine, MRI equipment is proficient at helping users detect lesions in parts of the body where X-rays are less likely to produce differences in brightness, such as the brain, spinal cord, muscles in the arms and legs, and organs in the pelvic region. Because it does not subject patients to radioactive exposure, there is increasing demand for its use in a wide array of fields, including diagnosis, treatment, and research. An examination generally takes 20 to 30 minutes, but may sometimes require more than an hour. Not only does this cause inconvenience to patients, but the limited number of scans that can be done in a day prevents medical institutions from performing as many examinations as they would like.

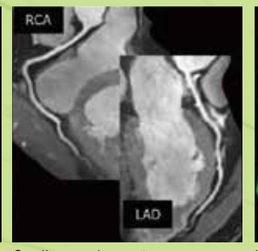
The water and fat content in the human body contains hydrogen nuclei known as protons. An MRI forms images by collecting information from echo signals that are emitted when electromagnetic waves collide with the protons. Differences in the echo signals appear on the image in the form of different levels of brightness. The signal weakens and appears white where tissue is normal, while the signal intensity remains high and the image appears black at the places where there is an abnormality. This contrast in brightness is an important feature of diagnostic imaging. However, images of the same location need to be taken multiple times in order to determine whether you are seeing signals or simply noise, resulting in prolongation of the test time. In order to resolve this problem, Canon Medical has been developing technology to overcome this obstacle.



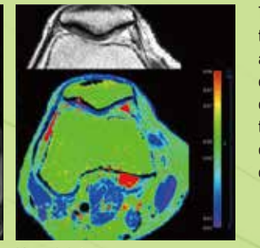
Images taken with an MRI



Cranial nerves



Cardiovascular system



Knee joint

The distribution of the magnetic field and frequency of the electromagnetic waves can be adjusted on the MRI system to capture images of different organs

Efforts to Realize a 3T Device Capable of Producing Images at 7T Quality

To both shorten MRI examinations and improve image quality, it is necessary to strengthen the magnetic field. Some MRI systems currently employed for general examinations offer a maximum field strength of 7 tesla (a unit of measurement of magnetic field strength). However, because the systems are larger and require a stronger, more robust scanning room and enhanced magnetic shielding capabilities, they can be installed at only a very limited number of medical facilities. As it is more practical for most of facilities to install a 1.5T to 3T MRI, Canon Medical has been devoting its efforts to developing a 3T MRI that is capable of producing images of 7T MRI quality. First, they worked on developing the gradient magnetic field coil.

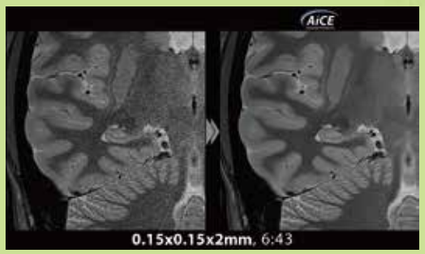
A gradient magnetic field works with the main static magnetic field to produce the magnetic field necessary to get a cross-sectional image. Canon Medical succeeded in strengthening the gradient field to enable capturing of images at a higher resolution than before. In addition, Canon Medical applied a high-speed imaging technique that involves capturing images at some instead of all data points, an approach that is also used in astronomical observation. At the same time, to minimize deterioration in image quality caused by reducing the number of data points captured, Canon Medical also created a unique algorithm to enhance both scanning speed and image quality.

The World's First Reconstruction Technology to Harness Deep Learning for Noise Suppression

Yet another new development is the Advanced intelligent Clear-IQ Engine (AiCE), a reconstruction technology developed for MRI makes use of deep learning to suppress noise. This development was made by training the neural network, the basis of deep learning, so that it suppresses only noise and retains structural details that should be captured in the image. This training required a vast amount of image data with very little noise, and members of the development team went through MRI images acquisition to capture about 30,000 images of their own bodies.

Reducing the Burden Placed on Patients and Medical Institutions

The 3-Tesla MRI system incorporates these latest technologies. Following the introduction of two new models, in April 2020, Canon Medicals also launched a 1.5-tesla MRI system in Japan that can incorporate the "Advanced intelligent Clear-IQ Engine (AiCE)". These systems aim to shorten the examination time, thereby reducing the burden on the patient, as well as enhance the diagnostic performance with higher image quality and improve work efficiency at medical institutions. Most importantly, it allows patients to receive more appropriate diagnoses and treatment.



An original captured image (left) vs an AiCE image (right)

Video Content Analytics Technology (Network Camera)

Network Cameras and AI Create Value for the New Era

Appropriate guidance and reliable security are essential in public facilities and event venues where many people gather. AI-powered Crowd People Counter technology significantly contributes to the efforts to ensure the safety of visitors.

For more information about Video Content Analytics Technology

AI distinguishes people's "heads" and counts the number of people in a crowd

Understands the number of people in the crowd in real time

Counting Thousands of People in Real Time

When it comes to assessing the number of people present at such crowded locations as event venues and how that number changes over time, manual counting has its limitations. In 2019, Canon released Crowd People Counter for Milestone XProtect, a software that uses video content analytics technology to count thousands of people in a congestion in real time. In a proof-of-concept test, the software was able to count approximately 6,000 people in a few seconds. When the results were compared with the number obtained by the manual count of people in the video, the software successfully provided a count of the crowd almost in real time with a margin of error below 5%.

Displays the changes in the number of people in chronological order

Aiming to Achieve High Accuracy Counting through Deep Learning

What characterizes Canon's Crowd People Counter technology is that it counts the "heads" of people using AI. It used to be difficult to count people in crowded locations by body or face because of people overlapping and facing different directions. To overcome these problems, Canon has developed the AI technology that distinguishes a person's "head" to make it possible to count the number of people in a crowd in real time.

At the initial stage of the study, in order to increase accuracy, the developers put markings on each human head to train the AI through repetition. By training its AI technology with image samples from a variety of angles, the system has become able to detect people from videos captured within an angle of depression (angle looking downward from horizontal) between 10 to 65 degrees. Supporting such a wide range of angle of depression allows for camera to be installed in a greater variety of locations.

To further enhance usability, Canon developed a lightweight AI model. This contributes to lower operational costs and power consumption.

The deterioration of counting accuracy under low light conditions has been solved by Canon's analysis method which takes into account the noise component of the camera body. Canon will continue to offer unique cutting-edge solutions supported by technologies of both high-quality, high-performance cameras cultivated over many years and software powered by constantly evolving AI.

Possible to count across a wide range of angle of depression (from 10 to 65 degrees)

Network Cameras with AI Generating New Value

Network cameras create new values with Crowd People Counter technology. For instance, by chronologically recording the number of visitors to a store, trends in crowd flow can be analyzed by time of day or day of the week. This makes it possible to adjust the inventory or plan an optimal allocation of security personnel to the anticipated number of customers. The changes in the number of people can be obtained in almost real time, which also helps the decision making to restrict admission and avoid overcrowding. At the same time, it is also possible to count people within a designated area on the screen, which is useful for obtaining information on the number of people at a specific booth at an event or in a specific area inside a station or airport.

Canon's Crowd People Counter technology enables more effective use of videos from network cameras and is now being increasingly deployed in a wide variety of fields.

Satellite Development

Canon's Challenge Taking Strides in the Direction of Space

Canon group is fully mobilizing its technologies with Canon Electronics Inc.'s entry into the micro-satellite industry. We are steadily hitting milestones towards exploring the final frontier : outer space.

For more information about Satellite Development

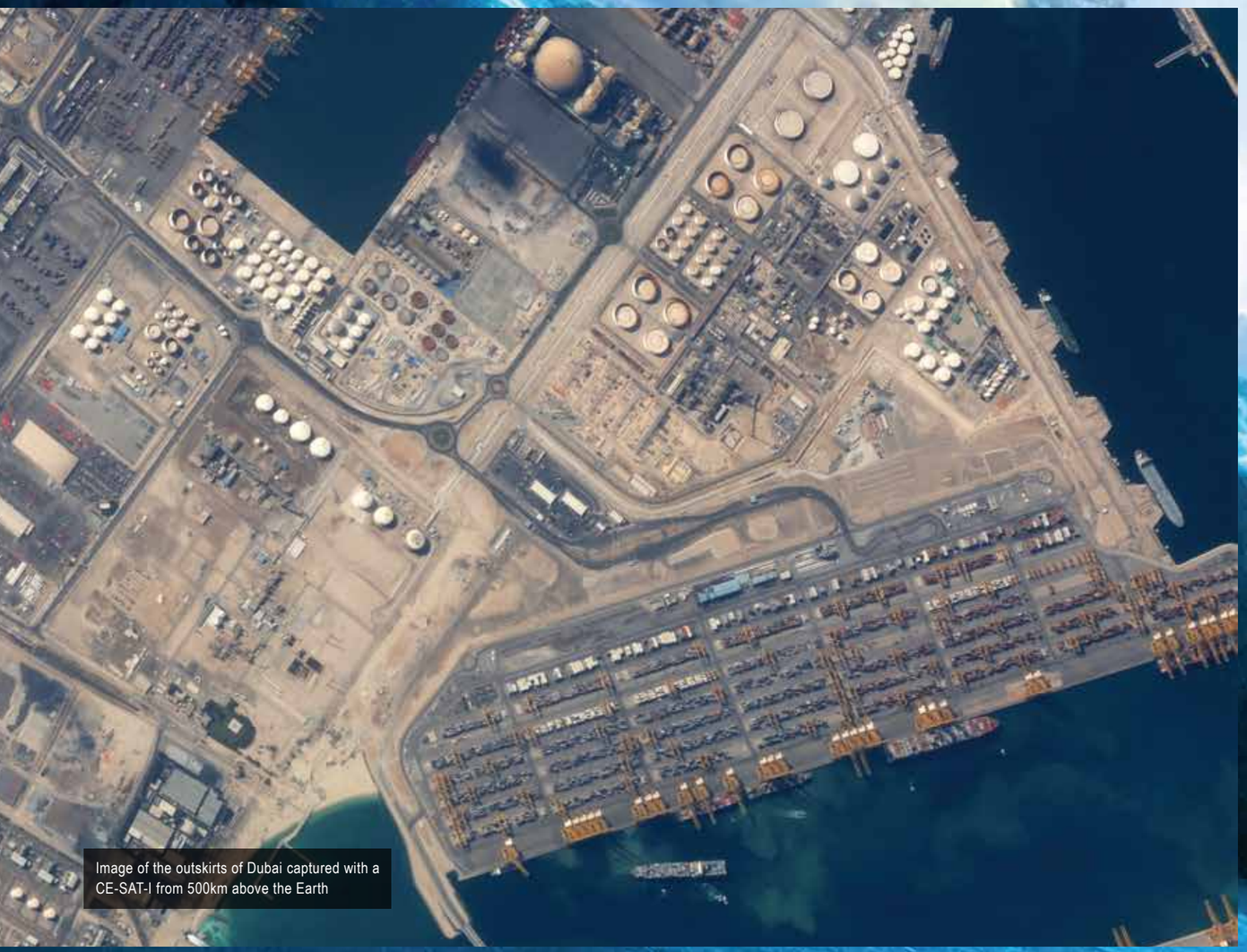
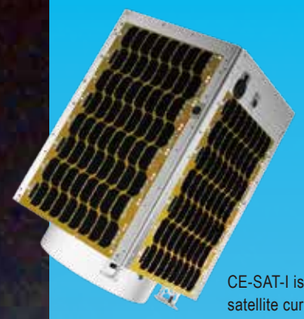
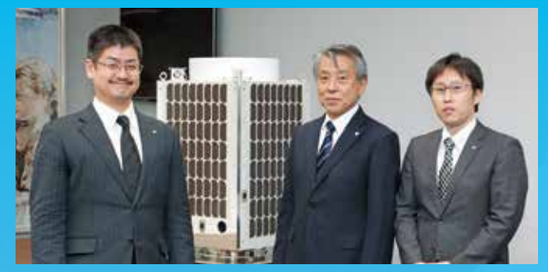


Image of the outskirts of Dubai captured with a CE-SAT-I from 500km above the Earth



CE-SAT-I is an ultra-small satellite currently circling the globe



From left to right: Nobutada Sako, Group Executive of Satellite Systems Laboratory, Canon Electronics Inc.; Tsumori Sato, Senior Managing Executive Officer and Group Executive of Space Design Center; and Yoshito Niwa, Group Executive of Satellite Strategy Development and Operation Center

Towards the Next Frontier

In 2017, a rocket carrying CE-SAT-I, a micro-satellite developed by Canon Electronics, was launched from a space center in southern India. 17 minutes and one second after liftoff, the micro-satellite entered space, successfully reaching its scheduled orbit. This tiny satellite, measuring only 500mm x 500mm x 850mm, was a major step forward for Canon Electronics.

The endeavor began with an order from the president of Canon Electronics, Hisashi Sakamaki (At that time): "In the future, a top company will be the one that can master space. Let's be a trailblazer that sparks a dream in the minds of young people."

Canon Electronics Space Design Center, Senior Managing Executive Officer & Group Executive Tsumori Sato, says he was initially quite surprised by Mr.Sakamaki's declaration. However, Canon Electronics already had the technological foundations needed to develop a micro-satellite—motor technologies for attitude control of the satellite, lens technology ranging from macro to zoom and miniaturization technologies for eliminating wasted space. In addition, Canon Electronics could leverage the electronic, mechanical, optical, materials and other technologies of the Canon group to make the satellite development possible.

This is how CE-SAT-I was developed. In the small chassis, the company fit in components such as digital single-lens reflex (DSLR) camera with a catadioptric optical system and compact camera for wide-angle image capture. By using the DSLR camera, the imaging system can provide a 0.9m ground resolution from a 500km orbit within a 5km x 3km frame size, making it possible to identify individual cars on the road. The compact camera can capture wide-angle shots within a 740km x 560km frame. More than three and half years after launch, CE-SAT-I is operating smoothly. On October 29, 2020, the second satellite, CE-SAT-IIB, was also successfully launched. It transmit image data to Earth every day.

Space: A Different Environment

Canon Electronics had confidence in its manufacturing capabilities, but developing a micro-satellite was no easy task. Ground and space are two entirely different environments. "We had real difficulties in three technical areas," says Nobutada Sako, Group Executive of Satellite Systems Laboratory, Canon Electronics Inc. "Firstly, the absence of gravity; secondly the vacuum environment; and thirdly the unrelenting radiation in space. "The challenges of operating in a radiated and vacuum environment were particularly difficult to overcome. We eventually solved the problem of heat dissipation by coming up with a radiative cooling method, using metal to conduct heat away from where it is generated, even in a vacuum. Radiation causes the risk of system stoppages and malfunctions. Our development team overcame this issue by testing a large number of semiconductor chips, and eventually found a moderately priced, commercially available chip that is resistant to radiation.

Semi-customizing the Satellite

Canon Electronics' micro-satellite project is proceeding smoothly, but designing an optimal business model for micro-satellite is still a major hurdle to overcome. Currently, the company plans to generate revenue through sales of micro-satellite, micro-satellite's components, and visual data recorded by the satellites.

According to Yoshito Niwa, Group Executive of Satellite Strategy Development and Operation Center, "In order to satisfy the needs of users, the semi-customization of satellites will be required. We are currently engaging in research and development to enable us to offer a greater range of variations in terms of the size of the telescope that is mounted on a satellite. In addition, the high-resolution images captured from space contain information that is valuable in many ways. We intend to further refine technologies for analyzing images to meet the needs of our clients."

Nanoimprint Lithography

The Ultimate Microfabrication Technology Revolutionize Semiconductor Industry

Semiconductor lithography equipment is used to transfer circuit patterns onto a semiconductor chip. By making further miniaturization possible at low cost, Canon's Nanoimprint Lithography technology is about to trigger a revolution in semiconductor manufacturing.

For more information about Nanoimprint Lithography

Nanoimprint Lithography The Ultimate Microfabrication Technology

The evolution of semiconductor chips correlates directly to the history of circuit miniaturization. The key to this miniaturization has been the shortening of light-source wavelengths and advances in lithography technologies. In the early 1990s, Canon introduced its i-line 365 nm wavelength (nm = nanometer, one billionth of a meter) steppers, making 350 nm resolution possible. In the late 2000s, new shorter wavelength light sources were developed, leading to the creation of an argon fluoride (ArF) immersion lithography system capable of 38 nm resolution patterning. At the time, it was believed that miniaturization had reached its technological limit. As the industry looked for further breakthroughs, including extreme ultraviolet (EUV) lithography, Canon sought alternatives to shorter wavelengths, establishing a new approach to circuit miniaturization. That approach was nanoimprint lithography (NIL), which exceeds conventional lithographic limitations and does so at lower cost. Capable of achieving line widths of under 15 nm using a simple process that lowers manufacturing costs, NIL is poised to revolutionize the semiconductor industry.

KIOXIA Corporation / Canon's nanoimprint semiconductor-manufacturing system is currently being studied mass production at KIOXIA's Yokkaichi plant

Overcoming Numerous Technological Challenges

Unlike conventional lithography technology that uses light to expose circuit patterns, nanoimprint lithography fabricates nanometer-scale patterns by pressing the nano-pattern mask (mold) onto the coated resin on the wafer surface to form circuits. Because the process involves no projection lens, it enables the faithful reproduction of the mask's minute circuit patterns on the surface of the wafer. However, because the circuit patterns are formed using direct transfer, the process requires nanometer-level control technologies for accurately positioning the mask and wafer, eliminating particle contaminants and other cutting-edge technology. Through the comprehensive development of hardware, software and materials technologies, along with environmental control technologies to keep microscopic particles in check, Canon successfully overcame these numerous obstacles.

One of the technologies Canon developed for nanoimprint lithography controls the amount and positioning of the resin that is applied to the wafer surface. This technology precisely controls how much and where the resin is applied to prevent it from being squeezed out when the mask is pressed into the resin, while also ensuring the formation of a resin layer with a uniform thickness. Likewise, when the mask is removed from the wafer, their relative positions must be optimally controlled to prevent the deformation of the convex circuit patterns formed in the resin.

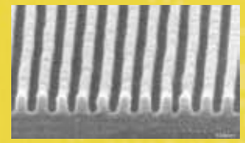
Generating Synergies from Different Cultures

With the aim of mass-producing nanoimprint lithography systems, Canon is collaborating with U.S.-based Canon Nanotechnologies, Inc. (CNT), which boasts some of the world's most advanced and unique technologies for microfabrication devices in the field of nanoimprint lithography. In addition to lithography system control and measuring technologies achieved through Canon's development of semiconductor lithography systems, Canon's service and support know-how will be merged with CNT's cutting-edge nanoimprint lithography technologies to break down the current barriers to miniaturization, once thought inviolable.

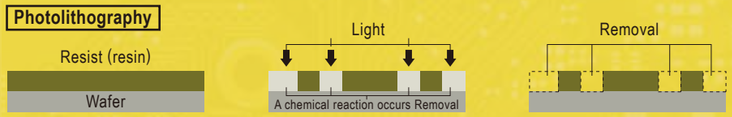
The FPA-1200NZ2C nanoimprint semiconductor lithography equipment is currently being studied for mass production with actual memory devices by a major semiconductor manufacturer.

Semiconductor Lithography System Celebrated Its 50th Anniversary Last Year

Last year, Canon Inc. announced the 50th anniversary of the company's full-scale entry into the semiconductor lithography equipment business with the launch of Japan's first semiconductor lithography system "PPC-1" in 1970. Canon semiconductor lithography equipment will continue to evolve in order to enable the advancement of digital technology.


The line-and-space pattern of 14 nm line widths formed with nanoimprint lithography technology
Source: KIOXIA Corporation

Photolithography



1 The resist (resin) for light exposure is coated to the wafer surface

2 A projection lens is used to reduce and project circuit patterns drawn on the reticle onto the silicon wafer, causing a chemical reaction in the resist

3 After development, the resist that was exposed to light is removed to create a circuit pattern

Nanoimprint lithography

1 Inkjet technology is used to dispense droplets of liquid resin to the wafer surface in accordance with the circuit pattern

2 A mold, called a mask, has the circuit patterns, is pressed like a stamp onto the resin that has been applied to the wafer surface

3 Ultraviolet light is used to solidify the resin and form the circuit patterns, after which the mask is removed from the resin

Canon's Nanoimprint Lithography technology leverages a simple approach of physically pressing patterns on a mask onto the resin. The simplified manufacturing process has the potential to significantly lower costs. Also, because this approach produces extremely sharp circuit patterns, it is expected to contribute to lower chip-defect rates.

imageRUNNER ADVANCE DX

Streamlining Work and Enabling More Flexible Working Styles

Creating new workflows with high-end, high-speed scanning and printing. Data sharing and cloud integration that can accommodate varied working styles.
Our multifunction devices (MFDs) are making work more efficient and furthering the adoption of flexible working styles.

MFDs are setting the pace of DX

Driving Digital Transformation in the Office by Integrating Multifunction Devices with Stronger Core Features with Cloud Services

Currently, the rapid development of “digital transformation(DX)” accompanying ICT technological innovation and the spread of cloud services is accelerating work style reform through such means as increased adoption of remote working.

Among such reforms, we have received various requests from customers regarding digitalizing paper documents in offices to make them easier to share.

Canon swiftly responded to this trend with the 2020 launch of the imageRUNNER ADVANCE DX (iR-ADV DX) series, which supports the promotion of DX in offices through such functions as filing assist, which makes possible automated and efficient electronic filing of paper documents. In addition to improving the scanning and printing speed of our MFDs, we have also enhanced other aspects of core performance such as energy saving and noise reduction.

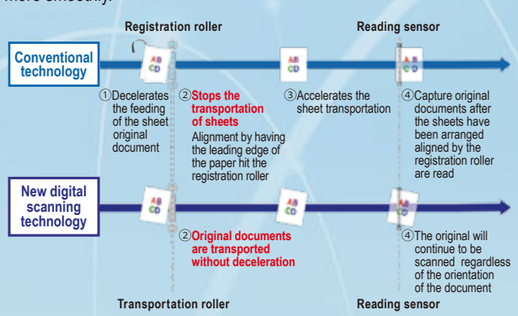
Combined with the seamless integration of cloud services, these devices contribute to the promotion of DX and increased productivity at workplaces.

Pursuing Core Performance Such as Improved Noise Reduction in Addition to Faster Printing and Scanning

Our MFDs are equipped with an auto document feeder (ADF) that enables convenient scanning of large volumes of paper documents.

With the iR-ADV DX series, the original document continues to be fed regardless of skew. The ADF detects the slight shadow at the edge of a sheet of paper, and a newly developed image-processing LSI chip instantaneously measures the angle of the slant and digitally corrects it. As the size and angle of the slant can be detected from the shadow, a registration roller is no longer needed to correct the slant mechanically, so it has been removed. This makes it possible to feed documents without decreasing speed, thus realizing a fast scanning speed of 270 pages (2-sided A4 paper) per minute. At the same time, the noise of paper hitting the registration roller has also been eliminated.

We have also significantly reduced the level of noise generated during printing by cutting down electrical current supply to the feed motor and altering the structure of the feed route to enable paper to pass through more smoothly.



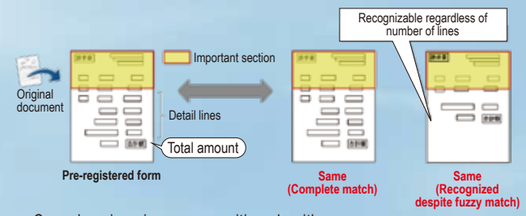
Comparison of conventional technology with new digital scanning technology

Intuitive and Reliable Archiving with Filing Assist

Digitalizing paper documents requires burdensome tasks to be carried out after the document has been scanned, including adding a file name and storing the data in an appropriate location. The filing assist function developed by Canon uses optical character recognition (OCR) and image recognition to automatically create file and folder names, then sorts and stores data according to users’ preconfigured settings.

This is done with Canon’s proprietary advanced OCR and document layout pattern recognition technologies. Rather than using character strings to recognize the content of a document, our layout pattern recognition technology recognizes layout patterns based on character placement.

It can recognize that documents are of the same group — even if the content and number of lines are different — enabling automated filing of almost any type of document an office may handle.



Canon’s unique image recognition algorithm

MFDs for the DX Era that Boost Office Efficiency through Cloud Service Integration

We have already launched new initiatives in collaboration with other companies, such as cloud service compatibility. For example, in a collaboration with partner company’s expense accounting system, multiple receipts scanned by a multifunction device are automatically transcribed accurately in a single batch process, enabling efficient expense accounting. Canon is responding to our customers’ needs by advancing DX, by integrating office multifunction devices and cloud services, to make office operations more efficient.

Commercial Printing

Digital Printing Technology is Ushering in a New Era of Expanded Choices for Printing

Achieving unprecedented high image quality for a wide range of print media. Digital printing enables a variety of output that can only be achieved digitally to meet diversifying commercial printing needs.

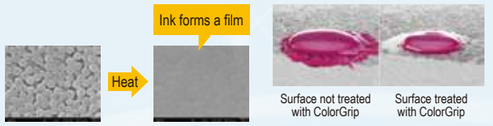
Commercial Printing is Undergoing a Shift to Accommodate Short-run Production for a Broad Range of Applications

Offset printing has been the mainstay of commercial printing to date and, while it is advantageous for printing large volumes, it employs thin aluminum printing plates which makes it cumbersome and not very cost effective for small runs. Digital printing has risen to the fore to address such concerns. Digital printing does not require printing plates, and it enables on-demand printing, in which only the amount needed is printed, and variable data printing, in which the content of each page is different. For example, direct mail typically involves sending the same message to many customers, but with digital printing, messages can be customized to fit the interests of each individual customer, resulting in improved customer satisfaction.

Realizing High Image Quality on Various Types of Paper through Advanced Ink Control and Proprietary High-precision Image Processing

Canon Production Printing has expanded its product lineup to provide products that meet the needs of printing businesses for on-demand printing. One such product is the ProStream 1000, a continuous feed press developed to realize high image quality printing of materials such as high-quality catalogs and premium direct mail advertisements.

The ProStream 1000 enables printing onto a wide variety of media with ColorGrip, the latest media-pretreatment used to prepare the paper surface to prevent the ink from bleeding. It also improves the durability of printed goods through polymer-based pigment ink (an ink containing a polymer component that forms a durable film). An inline sensor placed in the body of the printer detects banding and areas of unevenness with high precision and then optimizes the ink landing position for large and small droplets accordingly. This proprietary image processing enables Canon to realize the highest quality images in the industry.



Controls ink permeation and bleeding

Furthermore, our non-contact ink drying technology uses warm air to lift and feed paper through the printer without using a feed roller while simultaneously drying the ink. This avoids wear on the paper, producing high-quality printing on a range of media without compromising paper texture and gloss.

Inside the ProStream 1000 (Non-contact ink drying technology)

Canon’s Printers for Commercial Printing Satisfy a Wide Range of Needs Thanks to Advanced Technologies

Alongside the ProStream 1000, Canon is continuing to meet a broad range of printing needs with a varied lineup of commercial printers, including digital continuous feed presses and sheet-fed presses that can print books, manuals, and forms at high speeds, and large-format inkjet printers for producing drawings, posters, signage, and the like.

EOS R5

Unlocking New Possibilities for Visual Expression

Such vastly improved specifications are usually achieved only after lengthy development periods. However, by continuing to make breakthroughs, Canon has managed to produce a game-changing camera ahead of its time.

EOS R5

EOS R5: Conceptualized Years Ago, in Anticipation of Future Imaging Needs

High-resolution cameras for landscape photography, cameras capable of high-speed continuous shooting for sports, and cinema cameras for movie production — until recently, it was only natural for professional and advanced amateur photographers to decide which camera to purchase based on their specific photographic subject and use cases. However, photographers longed for a camera model that could handle any scenario, including landscapes, sports and video production, all in one camera body.

Fulfilling that desire is the EOS R5, an all-rounder camera released as one of Canon's second-generation full-frame mirrorless cameras. With its high pixel count of 45 megapixels*1 and support for 8K video recording, it also boasts a high-speed, high-precision autofocus (AF) system, up to 8 stops*2 of In-Body Image Stabilizer and high-speed continuous shooting.

Developing the camera required the union of advanced optical, electrical and mechanical technologies, and achieving a significant improvement in specifications requires time. Anticipating current and future imaging needs, Canon develops products years ahead of their time. The EOS R5 is one such product, achieved through a series of technological breakthroughs that would make the camera a reality.


Autofocus on a bird's eye
Photo taken in cooperation with Kakegawa Kachouen

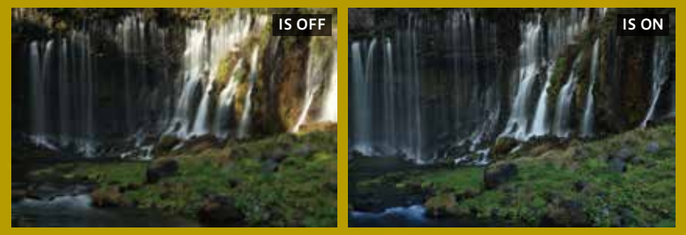


Image captured with IS off (left) versus IS on (right)

Go here for the EOS R5 introduction video

Delivering State-of-the-art Video Continuing the "5" Development Spirit to Realize 8K Video

The EOS 5D Mark II, released in 2008, was the first DSLR camera in the world to feature Full HD video capabilities. This sparked a new trend that could be considered a DSLR videography boom. The EOS R5, which also bears the significant number "5" in its name, was developed in the same spirit. Canon has spent more than 10 years developing 8K video cameras, and Canon 8K cameras are already being used in such applications as professional video production, academic research and the documentation of important cultural assets and natural heritage.

Recording in the 8K DCI 30p format supported on the EOS R5 requires processing a tremendous volume of data equivalent to thirty 35-megapixel still images per second. From developing a new 45-megapixel CMOS sensor and new DIGIC X image processing engine capable of high-resolution, high-speed readout, to addressing issues specific to 8K shooting such as the CFexpress card writing speed, the EOS R5's 8K recording capabilities were made possible by leveraging Canon's front-line experience in movie production, including playback environments.

It Can Even Recognize Birds' Eyes The Latest Autofocus Developed Using Deep Learning

Focusing exactly where the photographer wants, as though it can read the photographer's mind. This was achieved by incorporating deep learning technology into the camera's subject detection algorithm.

To enable subject tracking even during high-speed continuous shooting at up to 20 frames-per-second (fps), the EOS iTR AF X (Intelligent tracking and recognition) subject recognition capabilities of the EOS R5 were enhanced using deep learning, rendering the camera capable of detecting human heads as well as animal (dog, cat and bird) eyes, faces, and bodies. Ensuring high subject recognition accuracy through deep learning requires a massive volume of image data to "train" the system. For human head detection, a collection of sports-related images were used to train the system to reliably and accurately track the complex movements of athletes. Bird detection, however, posed a different set of challenges. There are many different species of birds, and even within the same species, the shape of a bird is drastically different when its wings are folded compared to when its wings are spread, which makes recognizing birds far more difficult than recognizing dogs and cats. From collecting training images from academic texts, to using their off time to test the bird detection capabilities by photographing birds. Canon's engineers personally strive to improve the technology, finally achieving high subject detection accuracy.

Hand-held shooting of Nightscapes and Waterfalls: Revolutionizing Handheld Shooting with up to 8 Stops of In-Body Image Stabilizer

Starting from the EOS R5, the second-generation EOS R system, cameras became the company's first camera to be equipped with an image sensor-shift type In-Body Image Stabilizer. This makes it possible to take slow shutter-speed shots of such scenes as nightscapes, or rivers and waterfall that harness motion blur effects, without the need for a tripod.

In order to make possible 8-stop image stabilization, Canon not only used high-precision gyro sensors, but also revamped the entire system to include a sensor unit that could accurately move the full-frame image sensor as well as an image processor and algorithms that could calculate sensor information from the camera body and lens in real time.

One scenario in which the camera's 8-stop maximum IS capability has proved invaluable is during long exposures, where even the slight movement that occurs due to the Earth's rotation tends to result in blurring in images. Due to the camera's high precision, this becomes a serious issue. In order to resolve it, Canon utilized an algorithm that detects the movement resulting from the Earth's rotation and factored it into the image stabilization function, thus ensuring proper stabilization. This results in ultra-high-precision IS that ensures the rotational movement of the Earth does not affect the sharpness of images.

An image stabilization system as precise as 8.0 stops is not something that can be achieved simply by putting together high-spec parts. The high quality and level of precision that makes it good enough to be a Canon product is the result of know-how cultivated by many years of developing, testing and manufacturing cameras.

Canon has created a camera that can capture images that were previously thought impossible, thereby expanding the range of imaging possibilities. Canon will continue to improve on the EOS R system's technologies as it aims to support the expansion of creative possibilities for photographers.

*1 45 effective megapixels. Actual pixel count: 47.1 megapixels.
*2 When using RF24-105mm F4 L IS USM at a focal length of 105mm. According to CIPA standards.

Manufacturing

Efforts to Further Advanced Manufacturing Technology

Canon is continuously creating high-quality products thanks to virtual prototyping technology, production technology and analysis technology.

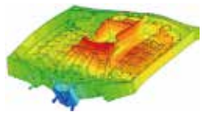
Manufacturing Technology Supporting "Canon Quality"

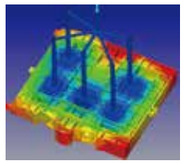
In concurrent engineering, development and production processes run simultaneously in order to greatly reduce time and cost while still creating high-quality products that support Canon brand. For the first stage of the product cycle that connects product development with the production site, Canon has developed original Computer Aided Engineering (CAE) and Computer Aided Design (CAD) tools and cultivated expertise that is utilized at a high level. We have systematized the tool technologies and the expertise as virtual prototyping technology. At the same time, on the production process, the second stage of the product cycle, we are realizing optimal production system tailored to meet demand and are striving to achieve high quality at low cost. Meanwhile, we are also pursuing automation and in-house manufacturing processes. The expertise and knowledge accumulated through this approach is being also applied to the manufacturing processes of many of our businesses. These technologies, and the advanced analysis technologies support Canon's high-quality manufacturing.

Virtual Prototyping Technology

Resin components are used in all manner of Canon products, including the bodies of cameras and office multifunction devices. Conventional resin components are made by melting and pouring resin material into a metal mold. However, various defects can emerge in this proess, including component warping (such as flat surfaces not coming out straight and flat) and insufficient strength. Canon has developed proprietary simulation technology using cutting-edge numerical analysis methods for the physical properties that resin flow, cooling and pressuring give to the shape of components when molded. We have bundled the analysis technologies as descrived above into a CAE tool suite for simulating a variety of phenomena that occur inside products, including allowing us to visualize paper jams and feed error in printers, as well as visualizing ink ejection process by formulating fluid mechanics equations.

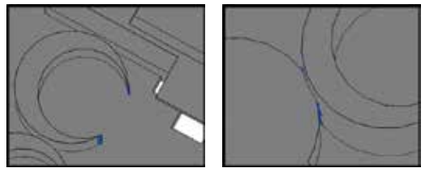
In addition, we have developed a proprietary mold inspection system which preforms such functions as checking whether component shapes made by CAD meet the design requirement of molds and giving instructions to designers if a problem exists.





Resin component warping

Optimizing resin gate placement



Checking sharp edges that can lead to insufficient strength for components and molds

Since Canon's founding, we have kept a database of the mold design expertise accumulated on the front lines of manufacturing and we incorporate the expertise into CAD functions that automatically alert users to such manufacturing problems as insufficient strength in molds. Defects and areas in need of improvement for component shapes designed using CAD can be immediately conveyed to designers, thus making possible more efficient development and manufacturing.

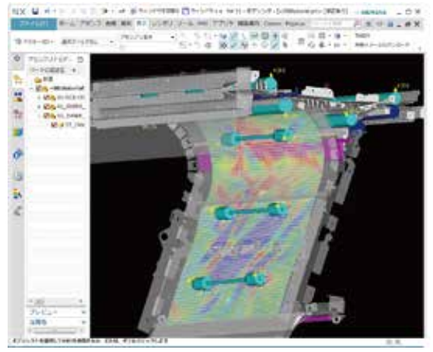
Production Technology

From the development stage, Canon carries out product design considering assembly automation. We have also built proprietary automated production systems for toner cartridges used by laser printers and office multifunction devices. These systems cover parts processing, product assembly, inspections, packaging and recycling. We are expanding the area of these automation systems to other products including DSLR cameras, mirrorless cameras, and interchangeable lenses, which we expect will lead to further cost reductions and improvements to quality. Through in-house production of key components that are crucial for product performance, Canon is working to ensure our products truly stand out and increase our competitive strength. For example, our glass mold technology is used to produce lenses by directly pressing a mold that has undergone ultra-precision machining onto glass at high temperatures, thus transferring the shape of the mold to the glass. The ability to easily change molds is one characteristic that makes glass molding a highly productive machining method—one which Canon uses to manufacture a variety of lenses.

Automated assembly lines

Analysis Technology

The stiffness of paper depends on humidity, temperature the process of ink and toner application. Furthermore, the friction coefficients of guides and rollers change with the type and material of paper. These physical properties that cannot be addressed theoretically have always existed, and current technology cannot perfectly simulate every phenomenon. Given this challenge, Canon is more accurately reproducing actual phenomena via simulations through the use of high-precision analytic equipment to make a database of these physical properties and by handling them as characteristic values in the simulations.



Paper movement simulation:
displaying the stresses acting upon media

We use high-precision measuring instruments and analytical technology to compile databases of various properties that affect product quality, such as the flow characteristics of high viscosity ink and the cooling characteristics of cooling equipment.

Intellectual Property Strategy that Supports Tomorrow's Business

The corporate intellectual property and legal headquarters at Canon implements the intellectual property strategy using patents, design rights, trademarks, copyrights, the right to seek injunctions under the unfair competition prevention law. This strategic management of intellectual property allows Canon to protect its proprietary technology, increase technologies that can be used through cross licensing and other arrangements, enhancing product development capabilities.

Basic Policy of Canon Intellectual Property Activities

1. Intellectual property activities are vital to business operations
2. The fruits of R&D activities are products and intellectual property
3. Intellectual property of other parties should be respected and attended properly

The Intellectual Property Strategy was First Launched against Leica

Canon's intellectual property activities began with the acquisition of an utility model for developing cameras in order to avoid patents held by Leica of Germany. In 1943, the company acquired its first patent: "a device that can release a light-shielding curtain once it has been fully wound up."

In the 1960s, in order to breakthrough the airtight patent wall which U.S.-based Xerox built around its copying machines, Canon succeeded in developing the NP method, an all-new electrophotographic technology that did not infringe Xerox's patents. Canon obtained patents for the NP method, which protected its proprietary technology that differentiated it from other companies, and also acquired patents for peripheral technologies. This put Canon in a position where it could negotiate with competitors for licenses of technologies Canon needed. This experience is the foundation of Canon's intellectual property strategy, which has been passed down to date.

Among the Top 5 U.S. Patent Recipients for 35 Consecutive Years and the Top Japanese Company for 16 Years

Canon believes that acquiring patent rights for its proprietary technologies is an essential aspect of expanding operations globally. Every year, Canon developers submit more than 10,000 ideas with patent applications filed by country and region.

In the United States, Canon has been the top-ranked patent recipient among Japanese companies for 16 straight years.

	Rank overall	Ranking among Japanese companies	No. of patents
2020	3	1	3,225
2019	3	1	3,548
2018	3	1	3,051
2017	3	1	3,284
2016	3	1	3,662
2015	3	1	4,127
2014	3	1	4,048
2013	3	1	3,820
2012	3	1	3,173
2011	3	1	2,818
2010	4	1	2,551

Number of Canon 's U.S. registered patents figures

*Figures for patents received in 2020 are based on numbers announced by IFI CLAIMS Patent Services.(As of January 14, 2021)
*Figures for 2010 to 2019 are based on information publicly disclosed by the United States Patent and Trademark Office (USPTO).

Participating in the Intellectual Property Partnership to Combat the Spread of COVID-19 as a Founding Member

Since May 2020 Canon has been cooperating in a collective initiative to use intellectual property to swiftly end the spread of COVID-19 as a founding member of the COVID-19 Countermeasure Declaration. According to this declaration, Canon has pledged not to enforce its intellectual property rights against development, manufacturing, and other activities whose sole purpose is to stop the spread of COVID-19.

For more information about Canon's Intellectual Property Activities ▶

Canon Design

Designing Ease of Use

High-quality design and new value with corporate activities. Increase brand value through a customer-centered approach to design.

User-focused Design

As Canon's business expands from cameras and printers to highly specialized fields such as healthcare and industrial equipment, we need to incorporate a deep understanding of these fields when designing. However, even with such major changes taking place both in the scope of our business and the roles therein, we have maintained the same design philosophy we have held since our inception — design for the people who actually use our products.

The user experience — when a customer engages with a company's products or services — links directly to the company's brand image. As the technology used in our products and their capabilities continue to evolve, design plays an important role in ensuring these products remain easy to understand and use.

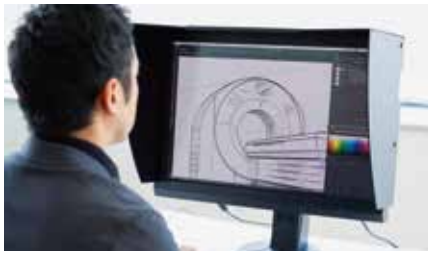
A Customer-oriented Design Approach

Canon's design process starts by gaining a deep understanding of the customer through various methods, such as interviews and behavior observation, so we can uncover any issues. Designers and developers work together to resolve issues, gathering ideas from many different perspectives. They create sketches and product prototypes to give these ideas a tangible shape, and then verify if it can resolve the customer's issue. By repeating this series of steps, they get closer and closer to producing the ideal user experience for the customer.

Canon will continue to enhance brand value through the pursuit of design that combines aesthetic beauty with ease of use.

Study-abroad Program for Developers

As part of its efforts to globalize research and development, Canon has offered a study abroad program for developers since 1984. For this program, developers are sent every year to universities in other countries. The design division also sends developers overseas through this program. This initiative develops people who can advance design from a global perspective.



Organizing issues through a workshop and using sketches to give an idea a tangible shape

For more information about Canon Design ▶

Global R&D

R&D of New Technologies Around the World

The Canon group conducts business around the world. Today,
sales outside of Japan account for approximately 80% of Canon's consolidated net sales.
To ensure that the research work from Canon's global R&D locations expands into businesses,
Canon's developers activity collaborate and engage in exchanges with research institutes.

1 Canon Research Centre France S.A.S.

Rennes, France

R&D of network and communication technologies for transmission and connectivity to high-quality, high-volume video date processing; and security camera systems and technologies.

2 Canon Medical Research Europe Ltd.

Edinburgh, U.K.

R&D of clinical decision support systems AI automation.

3 Canon Production Printing Netherlands B.V.

Venlo, Netherlands

R&D of large format printers, medium and high-speed printers, consumables, etc.

4 NT-ware Systemprogrammierungs-GmbH

Bad Iburg, Germany

R&D and sales/support of print and scan management solutions.

5 Milestone Systems A/S

Copenhagen, Denmark

R&D of video management solutions.

6 AXIS Communications AB

Lund, Sweden

R&D for network video and analytics, access control, intercom and audio systems.

7 BriefCam Ltd.

Modi'in, Israel

Development and sales of video analytics solutions.

8 Canon Medical Systems Corporation

Otawara (Tochigi), Japan

R&D of medical devices and systems.

9 Canon Medical Research USA, Inc.

Illinois and Ohio, USA

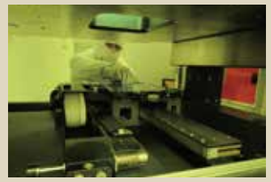
R&D of core system physics, data acquisition, and image reconstruction hardware and software for medical devices and systems.

10 Healthcare Optics Research Lab.(Canon USA)

Massachusetts, USA

R&D of minimally-invasive medical optical imaging systems and medical robotics.

11 Canon Nanotechnologies, Inc.



Texas, USA

R&D of nanoimprint lithography systems.

Canon Inc.

Headquarters (Shimomaruko)	R&D Areas, Development of digital cameras, etc.
Yako Office	R&D of inkjet printers, large-format printers, inkjet chemical products.
Kawasaki Office	R&D Areas, R&D of production equipment and dies, R&D of semiconductor devices, etc., and R&D of network cameras.
Tamagawa Office	R&D of quality management technologies.
Kosugi Office	R&D of medical devices.
Hiratsuka Plant	R&D of displays and next-generation devices.
Ayase Plant	R&D of semiconductor devices.
Fuji-Susono Research Park	R&D of electrophotographic technologies.
Utsunomiya Office	
Utsunomiya Optical Products Plant	R&D of semiconductor lithography equipment and FPD lithography equipment.
Optics R&D center	R&D of optical technologies.
Toride Plant	R&D of electrophotographic technologies, etc.

The Canon Technology Website

Better Understand Canon's Technology!

Our Technology Website provides a more complete picture of Canon's technologies. Users can access information about technology they are interested in through five categories–technology that realizing professionals' ideals, pioneering technology, mechanisms and technology, developers' story, and fundamentals that raise the value of technology.

https://global.canon/en/technology/

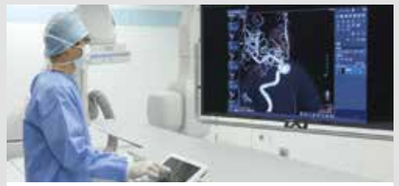
Revision scheduled for August 2021

Pioneering Technology | Canon's World-leading Technology that is Changing Society

Office Multifunction Devices: Leading the Way in Digital Transformation

Digitalize hardcopy documents quickly, accurately and quietly

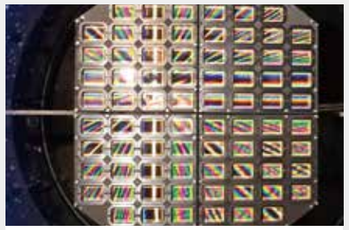
RF Super-telephoto Zoom Lens



X-ray Angiography

CHECK! SPAD sensor, Ceramic material for 3D printers, The Second-Generation EOS R System (R5), Technology Supporting Early Detection of Bone Metastasis, Satellite Development, Nanoimprint Lithography, The EOS R System, 8K Visual Solutions, Mixed Reality, Deep Learning in MRI, The Crowd People Counter, Next-generation HDR Technology, Detecting Cracks with AI Technology, Leading-Edge CMOS Sensors, Materials Research, Medical Imaging, Digital Commercial Printing, The Tsuzuri Project, Office Multifunction Devices with Expanded Functionality, Free Viewpoint Video System, CT Scanners, 3D Machine Vision, Helping Us Learn About Space, Subaru Telescope, Video: The Potential of CMOS Sensors, Video: Subaru Lens Unit Development, others

Realizing Professionals' Ideals | Technology that is Highly Regarded by the Professionals Who Use It



Watching the Movement of the Universe with 84 "Eyes"

TBS World Heritage Staff Discuss Canon 4K Cameras

Supporting a Revolution in Science Research

CHECK! Tomo-e Gozen, 8K Imaging Technology, Network Cameras, High-resolution 4K Cameras

Mechanisms and Technology | Making the Mechanisms and Technology Used in Technology-based Products Easy to Understand

Mirrorless Cameras

Network Cameras

MRI systems

CHECK! Inkjet Printers, Semiconductor Lithography Equipment, FPD Lithography Equipment, Commercial Printing Presses, Office Multifunction Devices, Large-format Inkjet Printers, Professional Displays, others

Developers' Story | Canon's Developers Share Their Passion for Technology and R&D

Redesigning the MFD from the ground up

Mixed Reality

Large-Format Printers

CHECK! Mirrorless EOS Kiss, Production Technologies, Nanoimprint Lithography, Crowd People Counter Technology, Ultra High-resolution CT, 4K Broadcast Zoom Lenses, Leading-Edge CMOS Sensors, 3D Machine Vision, 4K Projector, Network Camera, others

Fundamentals that Raise the Value of Technology | The Fundamental Technologies and Activities that Underpin Trust in the Canon Brand

Production Technologies

Common Platform Technologies

Intellectual Property Activities

CHECK! Canon Design, Strengthening Our R&D Capabilities, Open Innovation, Global R&D, Environmental Technologies, Quality Assurance Technologies, other

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