Committed to Supporting Social Values via Biometrics

NEC is a pioneering company that has been leading the way in biometric authentication technology for almost half a century. Operating on a global scale, our technology is setting the standard in more than 70 countries around the world where to date we have deployed more than 700 systems. Our worldwide presence can be attributed to the superior precision of our products, which are ranked number one in the world. NEC's fingerprint, face, and iris recognition technologies have been ranked first in benchmark tests conducted by the United States National Institute of Standards and Technology (NIST). In addition to our three primary biometric technologies, we also have finger vein, voice, and ear acoustic recognition technologies, which can be combined to create powerful multimodal biometric solutions. As one of the world's leading vendors of biometric technology, NEC will continue to strive for the achievement of safety, security, efficiency, and equality.

YOSHIDA Takashi
General Manager
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1. What Are the Distinguishing Characteristics of NEC's Biometric Technology?

The first thing that sets NEC apart in the field of biometrics is its long history. As the first company to invest in biometrics R&D, NEC pioneered the field and has been leading the way ever since. We first began studying fingerprint recognition in1971 and in 1989 turned our attention to face recognition. Always at the forefront of biometric authentication technology (**Fig. 1**), our technologies are known for their top-ranked precision and speed and have been adopted in many systems, particularly in law enforcement agencies and airports around the world. Now playing a key role in supporting social

A pioneer in the field with almost a half century of R&D of biometrics

2008: Development of finger hybrid recognition technology

2003: Ranked first in precision evaluation test conducted by US government

Late 1990s: Deployed worldwide.

Early 1990s: Deployed AFIS systems in various states in the US.

1984: San Francisco Police Department

1982: National Police Agency (Japan)

Towards multimodal authentication

Integration of various biometric technologies such as fingerprint, face, vein, and iris

2017: Ranked first in precision evaluation test conducted by US government for the fourth consecutive time

2009/2010/1013: Ranked first in precision evaluation test conducted by US government.

2003: Started shipment of NeoFace.

1999: Started shipment of face recognition system.

1996: Started research into 3D face recognition.

Fingerprint Identification

1971: Started research into fingerprint recognition technology.

Face Recognition

1989: Started research into 2D face recognition technology.

● Expanded usage areas into various aspects of daily life, while further improving biometrics through enhancement of technology and development of multimodal systems.
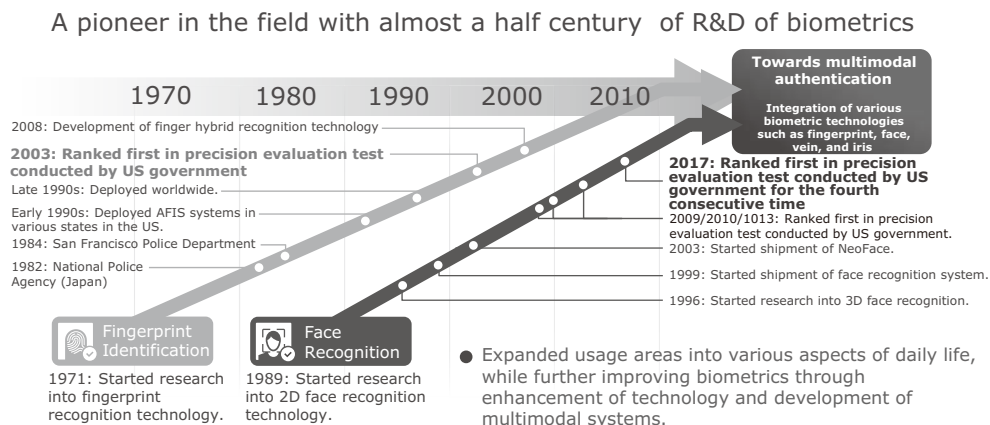
Fig. 1 NEC's commitment to biometrics.

infrastructure in different countries, NEC's biometric authentication technology is helping to support social values such as safety, security, efficiency, and equality.

To further strengthen and accelerate the development of biometric technology, NEC opened the Biometrics Research Laboratories inside the NEC Central Research Laboratories in 2018. All the staff who had previously been engaged in research into biometrics at the NEC Central Research Laboratories were concentrated at the new research center. This reorganization was critical to improving our R&D structure in order to better address societal demands as utilization of biometrics becomes ever more widespread.

The second thing that distinguishes NEC's biometrics is high precision. NEC's fingerprint, face, and iris recognition technologies have been consistently ranked number one in the world in tests conducted by the NIST (**Fig. 2**).

Thanks to the utilization of AI and other advanced technology, the precision of biometrics has recently taken a quantum leap forward. This is true even with companies in China and other newly emerging economies. In this competitive environment, NEC remains committed to maintaining its position as provider of the world's most accurate biometric systems.

The third thing that distinguishes NEC's biometrics is application versatility. Our systems are proving themselves every day in an incredibly broad and diverse range of scenarios. You can find NEC biometrics incorporated in national infrastructure operations such as immigration management and criminal investigation, corporate security such as log-on authentication and facility access control, and service fields such as omotenashi (hospitality unique to Japan) and marketing. And, of course, our technology is frequently incorporated in smartphones and other devices for personal security management, e-commerce, and so on.

One final distinguishing characteristic is technological abundance. In addition to fingerprint, face, and iris recognition technologies, NEC also possesses various other biometric technologies such as voice recognition and ear acoustics. All biometric technologies have their own advantages and disadvantages. By combining two or more according to the requirements of a given scenario, we can further strengthen the advantages and balance out the disadvantages. To promote our multimodal biometric systems, NEC launched a brand called "Bio-IDiom."

2. Utilization and Application of NEC's Biometrics – From Safety and Security to Efficiency and Equality

Biometrics is now widely utilized in areas ranging from national infrastructure to the most down-to-earth aspects of our daily lives. NEC's biometric systems got their start in the field of criminal investigation, proving invaluable to police departments around the world. We developed an automated fingerprint identification system (AFIS) that has been highly evaluated for its high precision. Today our system is used by many law-enforcement agencies around the world including in the United States.

Since the 1990s, biometrics has also played an increasingly important role in mission-critical national systems, especially in newly emerging economies. While individual authentication systems — such as census registration, driver's license, and health insurance, to name just a few — are firmly established in countries like Japan, many less-developed countries lack such systems. To enable these countries to establish mission-critical system and offer appropriate public services to their citizens, it is necessary to correctly identify and register each citizen and to ensure that high-precision, quick-response verification is possible.

Successfully used by law enforcement agencies around the world and highly evaluated for their speed and precision, NEC's biometric systems have been deployed in a wide range of applications such as national identification management, immigration management, and voter management.

The attacks on the United States on September 11, 2001 marked a turning point in the utilization and application of biometrics. Up to that point, biometrics was largely employed in criminal investigations to help specify suspects. Subsequent to 9/11, investigators sought ways to use the power of biometrics to help prevent crimes before they can occur. In response, the introduction of face recognition technology was accelerated. In 2002 and 2003 we began shipping NeoFace, an AI engine for face recognition. Since then we have received a steady stream of orders and inquiries, especially after

Biometric technologies ranked at the world's highest level by US government institution (NIST)

NIST: National Institute of Standards and Technology

Fingerprint Identification

FpVTE2003
FpVTE2012

Slap Fingerprint Segmentation Evaluation 2004

MINEX2016

Evaluation of Latent Fingerprint Technologies 2007 (ELFT2007)

NIST Proprietary Fingerprint Template Testing (PFT2009,PFTII 2013)

Face Recognition

Multiple Biometric Grand Challenge 2009 (MBGC2009)

Multiple Biometrics Evaluation 2010 (MBE2010)

Face Recognition Vender Test 2013 (FRVT 2013)

Face In Video Evaluation (FIVE)

Iris Recognition

Iris Exchange (IREX) IX 2018
Performance test/ Multispectral Evaluation

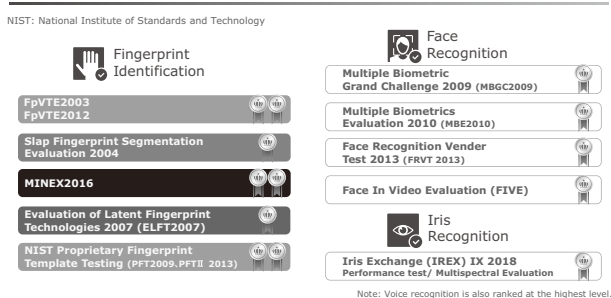Note: Voice recognition is also ranked at the highest level.

Fig. 2 NEC's world's top-class biometric technologies.

our face recognition technology was rated number 1 in benchmark testing conducted by the NIST in 2009.

As we have seen, NEC's biometrics has already contributed to the achievement of a safer and more secure society. Today we are moving in new directions, finding ways to deploy this technology to support increased efficiency and equality.

Even as utilization and application of biometrics in mission-critical national systems contributes to making society safe and more secure, it can also streamline business operations, which in turn leads to a more efficient and equal society.

Public awareness of just how useful face recognition technology could be soared when leading technology companies began deploying it in social media and smartphones. This soon prompted rapid expansion into many different fields. From opening a bank account or paying a bill to customer-focused hospitality service, building entry/exit management, robot engineering, and manufacturing, biometrics promises to radically improve the customer experience while creating new services with high added value. In the years to come, we shall remain focused on supporting the social values of safety, security, efficiency, and equality while striving always to shape our biometric technologies to better correspond with the needs of society.

3. NEC's Biometric Technologies

Biometrics is a personal identification and authentication technology that uses each individual's unique physical and behavioral characteristics as a means of accurately identifying them.

Under the umbrella of the Bio-IDiom brand, NEC is focusing on the biometric technologies listed below (**Fig. 3**).
- Face recognition
- Fingerprint/palmprint recognition
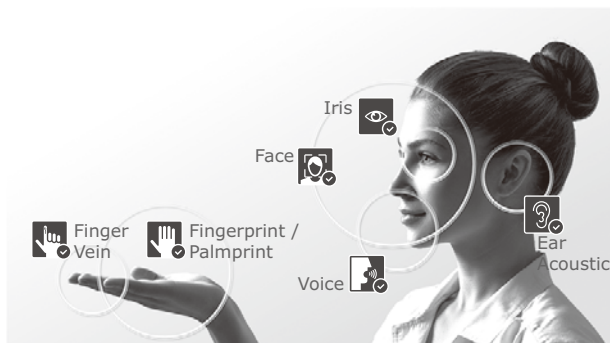- Iris recognition

Fig. 3 NEC's Biometrics.

- Finger vein recognition
- Voice recognition
- Ear acoustic recognition

Today NEC is the world leader in biometrics and all of its technologies are recognized as possessing the world's highest levels of precision. These technologies are introduced briefly below.

Face recognition

This is a technology capable of identifying individuals by detecting their faces in images and video and analyzing their characteristics. Because the face is the predominant means by which we distinguish and recognize other people, it can be regarded as the most natural identification system, one which imposes no psychological burdens or complex operations on users, making it convenient, reliable, and easy to use. Standard web cameras can be used, so no special hardware or complicated setup is required.

Fingerprint/palmprint recognition

Fingerprints and palmprints are widely used in systems that require rigorous personal identification technology because they are fixed at birth and are completely unique to each individual — no two are alike. NEC has been working in this area longer than any other, with a history of research and development that stretches back more than five decades. Our original recognition technology is capable of performing high-precision, high-speed identification, making it ideal in a wide range of applications. A dedicated scanner is necessary to use fingerprint/palmprint recognition.

Iris recognition

The iris is the thin circular structure in the eye that surrounds the pupil. Iris recognition is a technology that identifies an individual by analyzing the complex pattern of the iris, which is unique to each individual. To perform iris recognition, near-infrared illumination and a camera are required. This is very high-precision, high-speed recognition technology and can be used for a wide range of applications because the only part that needs to be exposed is the eye. While it works well for recognition in the dark, it is susceptible to strong external light.

Finger vein recognition

This is a technology that identifies individuals by detecting veins that run inside their fingers. There is little

risk of deception because finger vein information not visible from outside is used. An added benefit is that contact is not required, so no bioinformation is left on the surface of the device. However, dedicated scanner is required.

Voice recognition

This technology picks up the voice of an individual via a microphone and identifies them by analyzing their vocal characteristics. Since authentication is possible from a distance via the medium of voice, this technology is expected to be used in smart speakers and at call centers. Operation is easy and simple. All the user has to do is speak. No dedicated device is needed and it's not reliant on language, so it can be deployed globally.

Ear acoustic recognition

This technology exploits the distinctive shape of the ear canal which is different from one person to another. An NEC-original technology developed jointly with the Nagaoka University of Technology, it uses hearables and bases authentication on the acoustic characteristics of the ears. This is not only a high-precision, high-speed authentication technology, it is virtually impossible to deceive because the ear cannot be seen from outside. Confidentiality is assured because even if the hearable is stolen, the thief will not pass authentication and so will be unable to hear the communication.

4. Conclusion

As we have already pointed out, NEC is able to offer multimodal authentication by combining these biometric technologies. But NEC's broad technological base gives it the ability to go beyond the limits that constrain other companies. By linking our biometric technologies with other NEC-proprietary technologies such as image analysis technology, we can create new and unique values. In combination with crowd behavior analysis, remote gaze detection, and age and gender recognition technologies, our multimodal authentication systems are used for street surveillance on streets and entry/exit management at stadiums and other facilities.

NEC is that rare breed of ICT vendor that also possesses cutting-edge technologies in areas such as computing, networking, and AI. By leveraging such comprehensive strength and building on our achievements to date, we hope to help shape the world of the future in ways that will create a safer and more secure society where people are free to explore their dreams.

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Advanced New Technology Uses New Feature Amount to Improve Accuracy of Latent Fingerprint Matching
Safety, Security, and Convenience: The Benefits of Voice Recognition Technology
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