

WHITE PAPER

Deep Learning Facial Recognition System

Panasonic Video Surveillance Systems

The Panasonic logo is displayed in white text on a blue rectangular background. The text is in a bold, sans-serif font.

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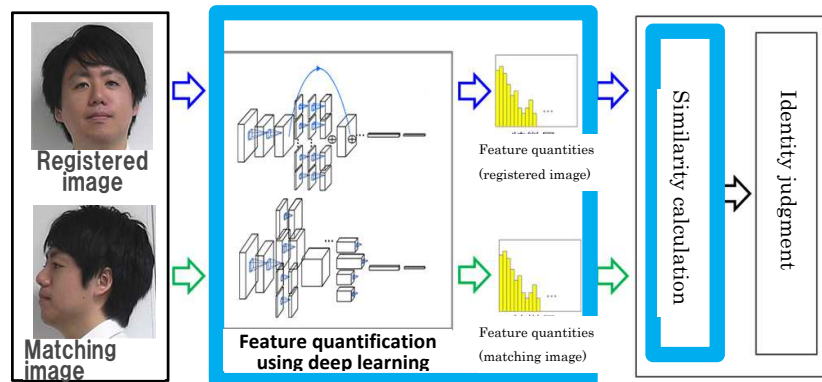
1. Introduction

Increasing attention is now being given to the monitoring of airports, train stations, shopping malls, and other important facilities where large numbers of people gather. In the security industry, there is a growing need for monitoring systems that can help to stop crimes before they happen. Rather than using high resolution cameras to passively capture people's faces and behaviors, there is a growing need to identify important and suspicious people to provide an active security response. In order to solve problems such as these, Panasonic has newly developed FacePRO, a facial recognition system which utilizes deep learning technology. With inbuilt analytics changing traditional monitoring, the system is better equipped to provide safer and more secure environments.

2. Deep Learning Facial Recognition Technology

With the Internet of Things (IoT) and Artificial Intelligence (AI) becoming popular concepts in today's society, industries are utilizing the ability to link together a variety of information to make workflows and people's lives easier. To achieve this, one of the technologies being applied in each field is the new technology known as "deep learning."

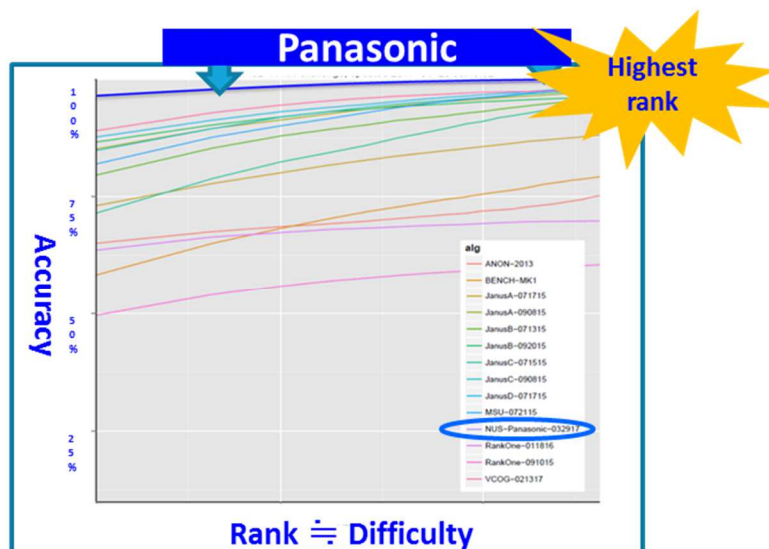
In a joint effort with the National University of Singapore, Panasonic has engaged in research and development that has led to the creation of an original algorithm combining the machine learning method known as "deep learning" with a similarity calculation method that suppresses errors. This algorithm has now been put to practical use in our facial recognition system. As a result, we have been able to improve the matching failure problems that have plagued conventional facial recognition technology in cases where faces are angled, changed by aging, or partially hidden by sunglasses, etc. This success in raising facial recognition accuracy makes it possible to expand the situations in which facial recognition systems can be used.



3. Panasonic's Facial Recognition System

3.1 High precision

The facial recognition software employs a face matching performance engine that utilizes deep learning technology jointly developed with the National University of Singapore. It has been rated at the highest level in the NIST (National Institute of Standards and Technology) IJB-A face challenge*¹, with the system accurately face matching in situations that were difficult to handle with conventional techniques such as faces that are angled (up to 45 degrees to the left or right or 30 degrees up or down), changed by aging, or partially hidden by sunglasses.



NIST (IJB-A) competition : Competition between corporate and universities to compete latest technology (unlike FRVT or FIVE)

*1 In April 2017, the product achieved the highest level of facial recognition performance in the world in a comparison test (IJB-A Face Verification Challenge Performance Report/IJB -A Face Identification Challenge Performance Report) of NIST (National Institute of Standards and Technology) of the United States, one of the most authoritative institutes in the world.



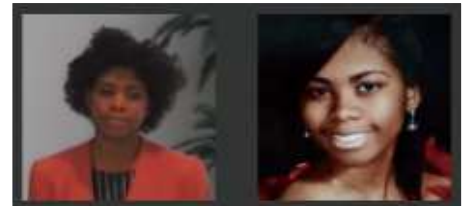
Angled Face
 Left/Right $\pm 45^\circ$
 Up/down $\pm 30^\circ$



Sunglasses



Surgical Mask



Changed by Aging

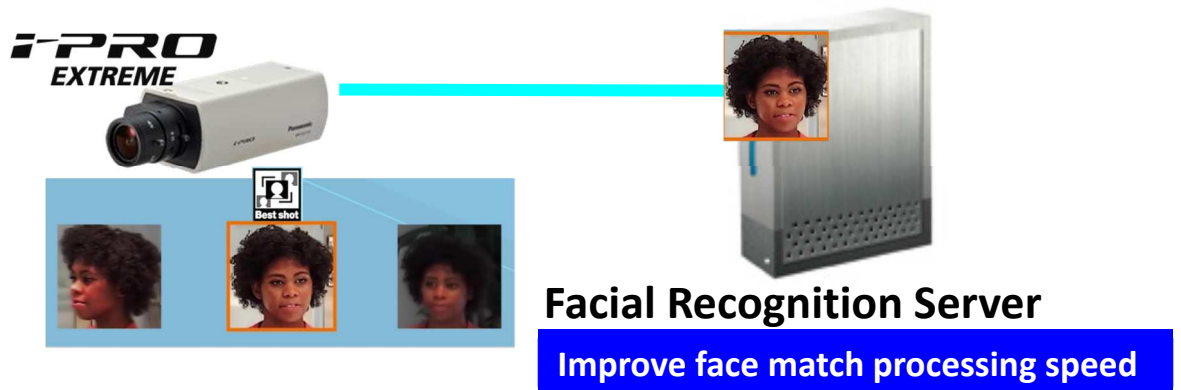
By using the intelligent auto(iA) and Best Shot*² function installed on Panasonic i-PRO Extreme cameras, it is also possible to maximize facial recognition engine performance and provide high recognition precision.

(iA function)

This function enables cameras to automatically recognize the scene and optimize the settings accordingly to improve the clarity of the video images. The camera detects the moving objects, movement speed, faces, and light intensity found in video that is usually hard to see due to subject movement and backlight, and it optimizes the settings in real-time to capture more optimal video of the subject.

(Best Shot function*²)

This function automatically selects several images suitable for facial recognition from the multiple face images captured when a person passes in front of the camera, and it sends only those selected images to the server. This enables high-quality images suitable for facial recognition to be sent without putting a load on the network.



With these functions, high-speed matching (matching in approx. 1 second*³ even with a maximum of 30,000 faces registered) and high-speed searching (searching data for 5 million faces in 3 seconds*⁴) can be realized.

*2 The Best Shot License Key must be installed on the i-PRO Extreme camera

*3 From receiving the face thumbnail to matching server

*4 The best case when the time range is narrowed down and the number of search result is 100 faces. Depending on the search conditions, the search time may take several minutes.

3.2 Cost Reduction

With conventional facial recognition systems, all captured images are sent to the server and the server performs face detection and recognition resulting in the processing load being concentrated on the server. Systems also tend to be large-scale because of the large bandwidth required to send all the images and the large volume of hard drive space required to save those images.

To provide a solution to data storage, Panasonic's facial recognition system uses the Best Shot function to only send Best Shot images to the server, thereby making it possible to eliminate the need for wide bandwidth and reduce the network load. In addition, performing facial recognition on the server using the Best Shot images reduces server load and hard drive volume usage so up to 20*⁵ cameras can be connected to a single server.

3.3 System expandability

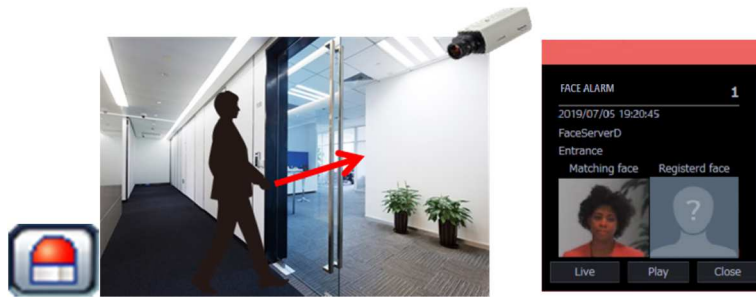
- Simple batch registration of a maximum of 10,000 faces is possible with the standard Facial Recognition Server Software (WV-ASF950). The optional Face Registration Expansion Kit (WV-ASFE951W) enables registration of up to 30,000 faces at large-scale facilities.
- Face detection, face matching, and tracking with recorded video can be performed in the same GUI by integrating management with the WV-ASM300 or WV-ASE231W client software for Panasonic i-PRO monitoring systems. This eliminates the need for the dedicated operation and management required for conventional facial recognition systems and enables work to be centralized.



*5 The number of cameras that can be connected depends on the number of people passing by the camera and the retention period for face images.

- Additional Unregistered Face Detection setting

The face recognition accuracy improved by the deep learning technology can be used for unregistered face detection as well as registered face recognition.



Detect unregistered persons

In areas where outsiders and suspicious persons are not allowed to enter such as the backyard of a store and company's development department, it is detect*⁶ persons other than registered faces with high accuracy and to notify an alert to field surveillance can be reinforced.

As a system configuration, in the case of unregistered face detection setting, maximum 10 cameras can be connected in a face matching server.

*⁶Detect unregistered faces in approx. 3 second even with a maximum of 30,000 faces registered depending of setting
Unregistered Face Detection and Registered Face Detection simultaneously.

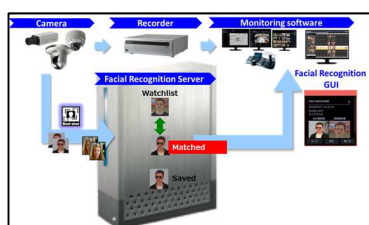
3.4 Data protection and GDPR legislation

Whilst working to increase the accuracy of facial recognition, Panasonic is also providing capabilities such as the ones listed below to strengthen the information security of facial data, and therefore build safety management into the system as a whole. According to the GDPR, a European of privacy protection regulations, facial data is a considered sensitive data which has to be protected.

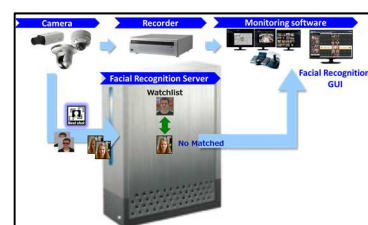
Hence, FacePRO supports multiple settings to comply with the European GDPR :

- Can be selected to store facial data.
- Face thumbnail in DB will be encrypted.
- SSL communication(Camera-Server-Client)
 - *Face cannot be reproduced from Metadata.
- Registered faces can be deleted after valid time frame.
- Face matching data can be deleted after valid time frame.
- Retention period and number of face data collected can be set.
- Log data for all the operation can be saved.

When matching
with registered face information



When not matching
with registered face information(Data is deleted)



4. Conclusion

By utilizing deep learning technology, Panasonic's facial recognition system makes it possible to build a high-precision facial recognition and video monitoring system that can perform more complex and sophisticated monitoring centered on people. Furthermore, by cutting data volumes, this technology will also contribute to reductions in transmission, network-construction, and operation costs.