NEC's Approach to VCA Solutions Using Image Identification/Recognition Technology

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Abstract

The advancement of digitalization and the image quality improvement of surveillance cameras has expanded use of the computer analyses of camera images for various applications, such as for monitoring and personal authentication. NEC possesses image analysis technologies that feature the top performance worldwide[*1][*2] in the fields of both subject and individual identifications. The company is aiming at a systematic arrangement of its image analysis technology for use in a wide range of applications. These will include; a face recognition solution that identifies individuals from their face images for use in offering hospitality to VIPs, etc., a behavior detection solution that detects human behaviors for use in crime prevention, etc., and an object identification solution that can be used to collect retail inventory information or to check the parts assembly situations of manufacturers, etc.

Keywords
VCA (Video content analysis), face recognition, subject identification, object detection, behavior detection.

1. Introduction

The recent advance of digitalization of surveillance cameras has been promoting improvement in the quality and resolution of monitored images. On the other hand, the technology for analyses of images obtained with cameras is also making progress and is expected to be applied in many fields. Particularly, if work previously done by human eyes is replaced by computer analyses of images obtained with IP cameras and digital cameras, it would be possible to create new solutions that can substitute for human effort.

At NEC, we possess various image processing technologies at the world leading level that is high enough to implement the world as described above, and we are planning to develop new solutions using these tools by systematically arranging the image analysis technologies to build VCA (Video Content Analysis) solutions and by providing them to various fields.

2. VCA Concept

An image analysis service system is mainly composed of the following four layers.

(1) A data source layer that generates content obtained with IP and digital cameras
(2) A storage layer that stores obtained data
(3) An image analysis layer that analyzes images
(4) A service layer that provides various services

In this paper we propose a mechanism for extracting humans and objects and their situations by using the image analysis layer as the VCA platform (**Fig. 1**). We apply various analysis technologies including face recognition, object identification, behavior detection, Crowd Behavior analysis and personal characteristics estimation (age range and gender) to the collected images. Combining these analysis technologies allows us to implement a wide variety of services. Since an image contains much information, the implemented services extend over a wide range from crime prevention to customer support and marketing.

[*1] NEC gained the top ranking in the face recognition evaluation vendor tests of the U.S. National Institute of Standards and Technology (NIST) in three consecutive times in 2009, 2010 and 2013.
[*2] NEC developed sensing technology that identifies more than 100 articles correctly and instantaneously for the first time in the world (announced on December 5, 2012).

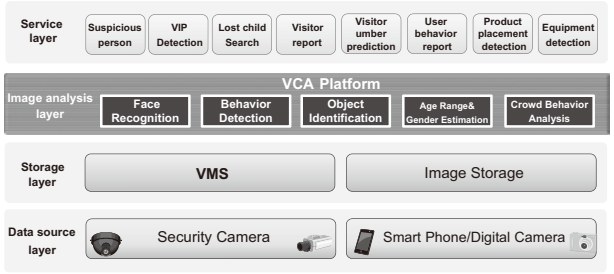

Fig. 1 Concept of the image analysis system.

3. Scenarios of Service Applications

This section introduces the specific scenarios in which the three representative functions of "face recognition," "behavior detection" and "object identification" are applied.

3.1 Face Recognition

Person identification based on face image is expected to improve crime prevention and various other services. For example, at a concert or a theme park, the entrances of legitimate users, such as those persons that actually purchased annual pass, can be confirmed by face recognition while preventing abuse.

If a hotel registers the face of a frequent user in advance under his or her permission, the person can be detected automatically at the next visit and enjoy hospitality services such as a smooth check-in.

On the other hand, it is also possible to register an undesirable guest who has caused trouble before as a suspicious person. If such a person visits the facility again, he or she can be detected in order to avoid a possible trouble and to thereby improve the crime prevention level.

3.2 Behavior Detection

Security at large commercial facilities such as shopping malls is usually performed by cameras and/or security officers. However, the recent trend in building very large malls has been making it harder to monitor every corner continuously. Even in such a situation, the system can improve the safeguarding efficiency by automatically detecting abnormal behavior. For example if a man falls down and is surrounded by a crowd of people, the security guards may be alerted.

3.3 Object Identification

The need for job efficiency improvement by making use of images has been rising recently. At present, when a dealer or beverage/food manufacturer wants to check the display situation at the shop, it is necessary to check each and every goods, which necessitates a huge amount of labor.

With the present technology being capable of identifying multiple objects simultaneously, it becomes possible to identify each goods from a shelf image that captures the displayed products. This enables the efficient collection of the displayed information (Product placement (planogram)) as well as the article display situation information of auto vending machines etc.

If image recognition is added, it is also possible to use this function in the inspection of external views of production parts in the manufacturing industry or of the parts mounting situations of installed equipment.

4. System Images of VCA Solution

This section describes the system image of each of the face recognition, behavior detection and object identification functions.

4.1 System Image of Face Recognition

NEC's face recognition technology boasts world leading accuracy[*1]. Based on such a performance, we are able to implement real-time, highly accurate face recognitions of multiple persons.

Before this function is used, it collects the face image of each person to be subjected to detection, generates the feature points from the face image and registers the result in a database. In the scenario of actual use, the system detects faces from the image captured with a camera and generates the feature point data from each detected face image. Then, the generated feature point data is collated with the master data of the previously registered feature points (feature point database) and a matching person is output as the detection result (**Fig. 2**).

The VIP and suspicious person detections are required to detect specific persons from an undefined number of users in real time, and the detection accuracy becomes higher when the amount of image information is larger. Consequently, we implement highly accurate personal identification by obtaining

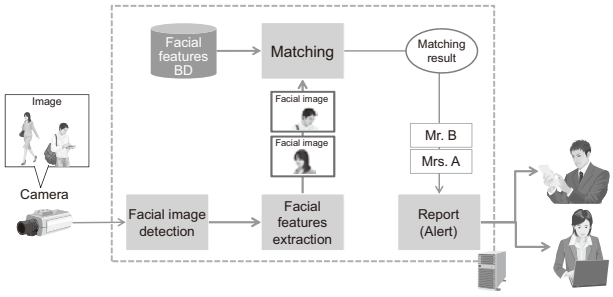

Fig. 2 System image of face recognition.

tens of face images per second from the camera.

4.2 Behavior Detection

Detection of specific behaviors requires that the machine has the understanding of what the specific behaviors are. This function detects specific behaviors from images by learning various human behaviors via the deep learning technology that is currently attracting attention. The deep learning technology used in the present context is NEC-original "NEC Advanced Analytics - RAPID Machine Learning V1.1" that can detect human behaviors with high speed and accuracy.

Before this function is used, it learns the prescribed behaviors and generates the dictionary data (educator data) that is used as the guideline for detection based on the learned results. Then, in actual use, it judges whether or not the actual image information obtained from the camera contains any suspicious behavior to be detected by comparing it with the detection model (**Fig. 3**).

The judgment results can be used in routine jobs by notifying the relevant workers (e.g. store manager, etc.) of the details.

4.3 Object Identification

In order to use this function in actual work, it is not only required to identify a single object (goods, etc.) but also to identify multiple parts or articles. NEC has developed a technology that identifies multiple articles simultaneously and senses their types and numbers with high speed and accuracy as a world first solution[*2]. In combination with this function, we also use a technology that performs a high-speed, high-accuracy grouping of feature points based on the multiple feature point data (key point) positions extracted from the images. We can then identify which feature point group corresponds to which article by collating the data with the image database (feature point database of articles and parts) (**Fig. 4**).

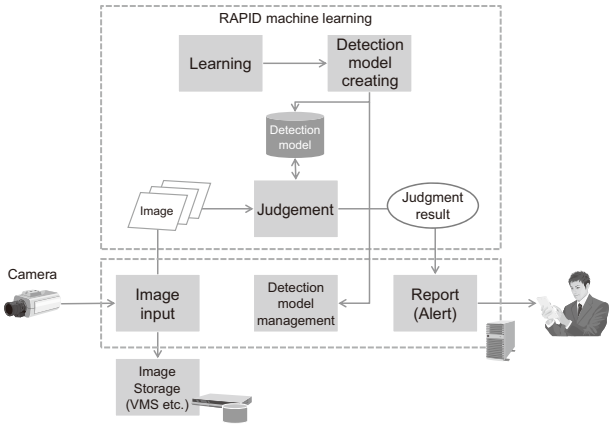

Fig. 3 System image of behavior detection.

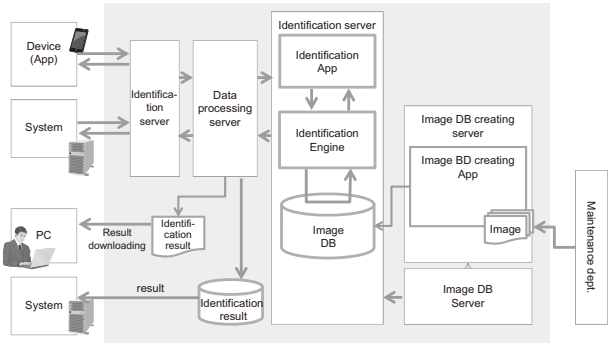

Fig. 4 System image of object identification.

5. Conclusion

In the above, we have described the VCA technology that uses image information from cameras and the scenarios in which they are applied.

In the future, we will aim at implementing even more advanced services by combining with the big data analysis technology. For example, by predicting the intended behavior of persons based on images captured with a camera.

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