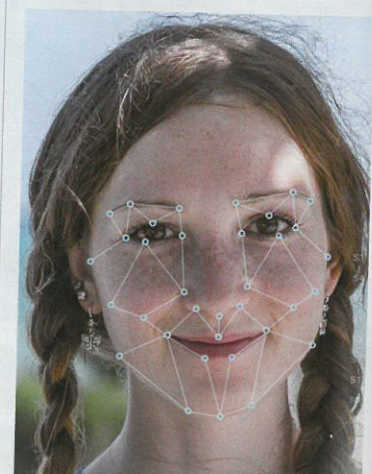
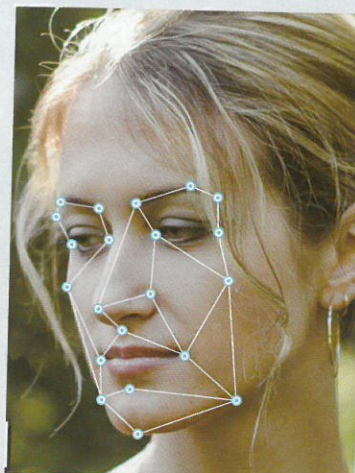
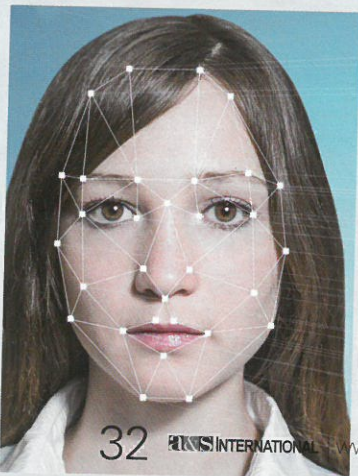
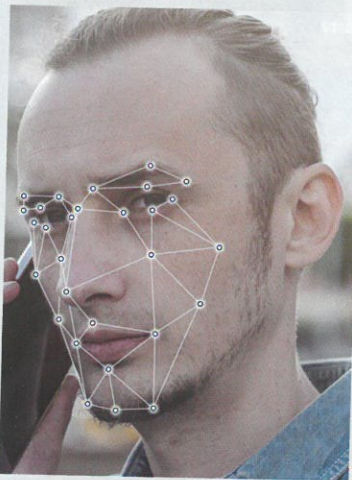


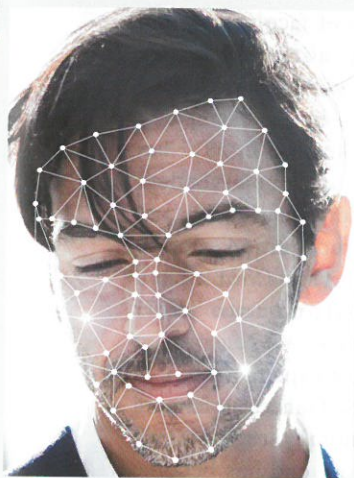
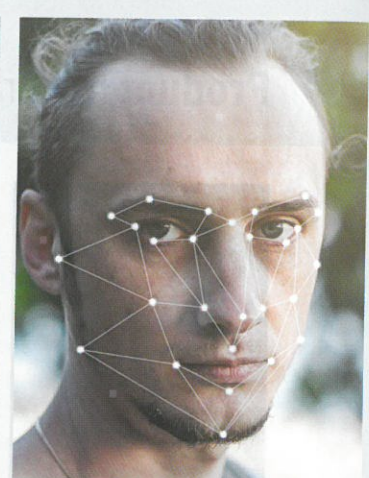
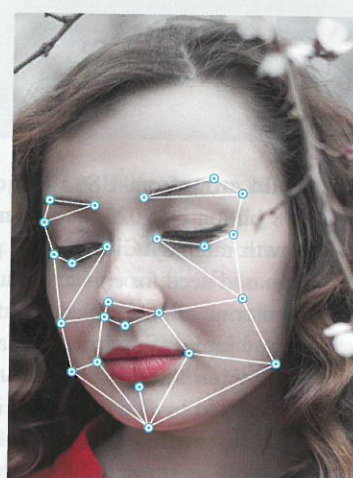
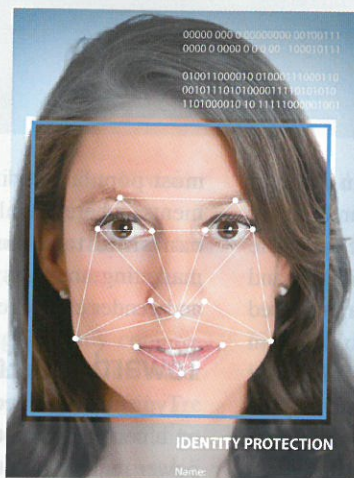
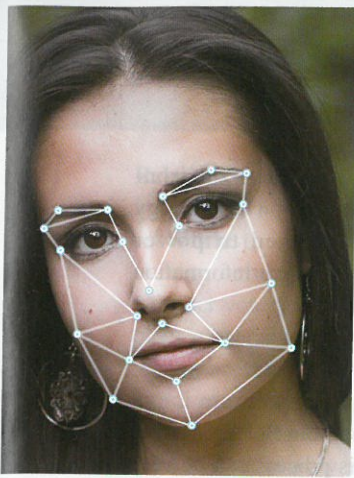
Product Exploration

Smart Cameras Bring Facial Recognition to the Edge

Face recognition has become more common than ever. The technology can be used for both security and non-security purposes. More and more, face recognition is moving toward the edge, as smart cameras embedded with face recognition and deep learning capabilities help users achieve their various objectives.

• BY William Pao



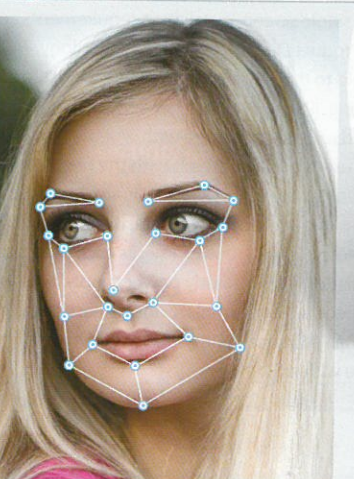
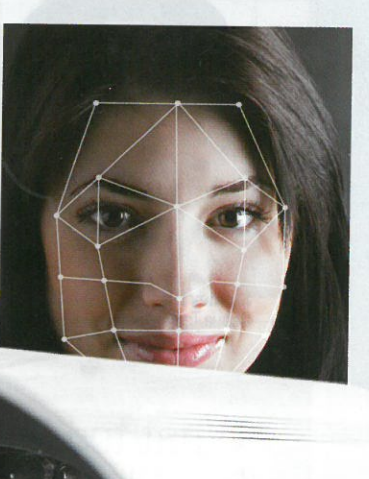
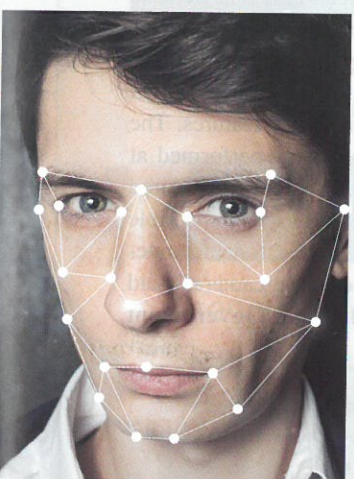
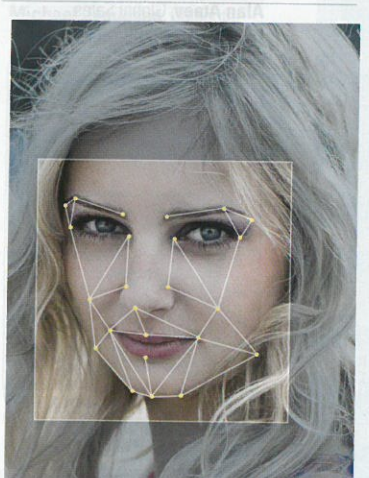


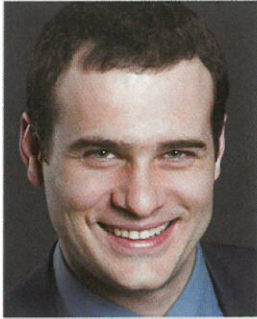
Face recognition is now seeing increasing deployment among end-user entities due to its effectiveness in identifying individuals. "Face recognition is the sort of basic capability that could be useful across a very broad range of vertical markets. An automatic system to recognize a person out in the world and connect them with all the other times they have appeared is quite powerful," said Michael Jamieson, Computer Vision Scientist at Senstar.

The primary goal for deploying face recognition is still to secure people and assets against criminals, terrorists or other unwanted individuals. "Face recognition is used a lot in safe city, smart city and airports. In these environments, face recognition is frequently used for identifying blacklisted people," said Sadi Vural, President and CEO of Ayonix.

"Facial recognition software is making video surveillance systems highly effective in terms of minimizing the threat associated with criminal activity. It can be used to provide alerts when blacklisted people enter the building," said Karen Sangha, Field Marketing Manager for Security Solutions at Panasonic. "This happened at DonauEinkaufszentrum shopping center, 70 miles north of Munich, Germany. It followed a robbery out of hours, when a cash till was stolen. Two weeks later the center's security team was alerted by the system that the suspected robber had triggered an entrance camera and were able to apprehend him."

In fact, stopping crime is one of the main growth drivers for face recognition, which MarketsandMarket forecast





Alan Ataev, Global Sales Director, AxxonSoft



Jerry Hong, IP Product Manager, Hikvision Digital Technology



Stanley Hu, Product Director, Dahua Technology

would grow from US\$4 billion in 2017 to \$7.8 billion by 2022, at a compound annual growth rate (CAGR) of 13.9 percent. “The increased need for enhanced surveillance and monitoring at public places and the increased use of facial recognition technologies in industries such as the government are expected to be driving the facial recognition market growth,” the market research firm wrote in a report. “Facial recognition technologies are used to minimize the threats associated with terrorism and border securities. The growing need for surveillance at public places is expected to be one of the major factors that drives the growth of the facial recognition market.”

“Recent developments in facial recognition software not only focus on the need for improved security, but also provides greater levels of insight into customer types and behavior than ever before.”

Beyond security, however, face recognition is used for various purposes as well, for example helping the end user gain better business intelligence. “The recent developments in facial recognition software not only focus on the need for improved security, but also provides greater levels of insight into customer types and behavior than ever before,” said Sangha. “The use of such analytical capabilities is shaping and changing the way businesses see operations and the way they work for the better. The

most popular use is within retail environments, where facial recognition technology can simultaneously be used to power marketing analysis, such as age information and gender evaluation.”

Toward the Edge

Typically, face recognition software is run on a server due to the amount of processing power required. But this process can be very time-consuming, expensive and difficult to meet the wide range of face recognition needs in the market. As a result, manufacturers have launched cameras with face recognition capabilities. In one example, a chip that Qualcomm developed in 2017 has enabled camera vendors to add human detection, face recognition, motion detection and other functions into their products.

Most experts agree that with advances in camera technology, running face recognition on the front end has become more and more feasible. “Yes, this trend is certainly emerging. It is important to distinguish facial detection from facial recognition. The camera primarily does the facial detection and extraction of key features. The facial recognition is primarily performed at the server in order to match the face captured with the listed faces. However, it is possible that more and more of the facial data extractions will be performed at the camera,” said Walter Lee, Evangelist and Government

What to Look for When Purchasing Face Recognition Cameras

When selecting face recognition cameras, several things need to be looked at to get the right product at the right price.

“In general, the better the resolution, the further you can see. The more light-sensitive is the camera, the better you can see in poor lighting conditions,” said Walter Lee, Evangelist and Government Relations Leader for Global Safety Division at NEC.

“Systems integrators should pay more attention to the recognition accuracy, the front-end face gallery capacity, the maximum number of faces under a single screen, installation requirements and adaptability to complex project environment,” said Stanley Hu, Product Director at Dahua Technology.

“For users, more attention should be paid to the performance of the product, such as the false acceptance rate and false recognition rate,” said Jerry Hong, IP Product Manager at Hikvision Digital Technology. “In addition to the abovementioned, integrators should also be concerned with whether the product meets compliance, and whether the overall solution meets the user’s business needs with the best cost-performance ratio.”

Meanwhile, how to set up the cameras to get the optimal results is also important. “Systems integrators should deploy the cameras based upon actual parameters of the camera, the type of camera and the actual business needs of customers. Usually they need to avoid poor environments such as strong backlight, large bevel angle, darkness, distance, unstable base installation and unsteady power supply,” Hu said. “Priority deployment should be in major roads facing the stream of people. For example, Dahua smart capture system is suitable to be installed in the entrance to park and shopping mall entrances, with a suggested installation height of about five meters, which delivers multi-target face capture within 50 meters.”

Relations Leader for Global Safety Division at NEC.

“While there are many approaches for making networks faster and more compact, I expect you wouldn’t be able to run one on older cameras without significantly compromising accuracy or frame rate. On the other hand, cameras with specialized hardware such as the Nvidia Jetson module should be able to comfortably run a strong network,” said Jamieson.

“Normally, a maximum of 10 cameras can be connected to a single Xeon server. If they use 1,000 cameras, it means 100 servers must be used. This is overpriced and a lot of maintenance and support is needed. Integrators must be careful on this. Embedded cameras solve this problem greatly,” said Vural. “Recently we have integrated 3D face recognition engine to Axis P1367 camera, which runs face detection, tracker and 3D face analysis; extracts gender, age and expression; and generates face template. The face template is then sent to the Milestone Xprotect server. One server

can handle up to 10,000 cameras in one single server machine.”

A main benefit of face recognition cameras is that the recognition process can be done on the front end. “It can be widely used in fields such as police identity verification, key blacklist and whitelist distribution control, facial similarity analysis, key object reminder and human trajectory analysis, saving cost for the users regarding the entire set of intelligent system deployment,” said Stanley Hu, Product Director at Dahua Technology. “Based upon face recognition, the camera can be widely integrated with the existing business of customers, such as face-recognition-powered on-site check-in into conferences, kindergarten enrollment statistics and important visitor alerts to enhance the service experience of the customers’ existing business.”

The features and functionality that face recognition cameras provide make them suitable for safe city projects. However, there are use cases in other applications as well. “For airports, stadiums and other large public



Michael Jamieson, Computer Vision Scientist, Senstar



Walter Lee, Evangelist and Government Relations Leader, Global Safety Division, NEC



They see the big city.

You see the big picture, with integrated safety and security solutions.

Bosch empowers you to build a safer and more secure world. With practical solutions that work in concert to give you peace of mind, no matter how big your requirements are.

Find out more at boschsecurity.com



Product Exploration

areas needing security, cameras can be deployed at entrances and exits. Upon detecting a suspicious individual, the camera can compare his/her face against the blacklist and trigger an alarm if there's a match," said Jerry Hong, IP Product Manager at Hikvision Digital Technology. "Also in casinos, face recognition cameras can prevent repeat offenders from committing crimes."

"In addition to monitoring in cities, face recognition cameras can also be widely used in airport, station, building, finance, retail and other solutions. For example, in airport and station solutions, face recognition cameras can be used to distribute and control key blacklist personnel, arrest criminals in a timely manner and identify personnel with criminal records to make pre-judgment on malignant events," Hu said. "In intelligent building solutions, you can deploy face recognition cameras at the entrances and exits of compounds so as to confirm the identity of the proprietors, which enables the property companies to release the barrier gates in advance, enhancing their management experience. In financial and retail solutions, you can identify the identity of customers in advance to determine their membership identity, based upon which you can do targeted sales promotion strategy, virtually provide customers with ubiquitous service and create accurate sales opportunities."

Hardware Requirements

To run face recognition on cameras, strong computational power is required, and this had been a challenge for vendors. "The main difficulties are as follows. If you have all recognition tools on-board — that is, face capture, biometric vector modelling and comparative search — the entire facial database has to reside on the camera. But the computing resources of the camera put a limit on the file size. If you use the edge analytics only for modeling vectors, while the database is processed on the server side, then the algorithms on the camera and on the server must be absolutely identical. This will entail agreements between the camera manufacturer, the developer of the recognition algorithm and the VMS vendor," said Alan Ataev, Global Sales Director at AxxonSoft.

With advances in camera technology and hardware, this has become less of a problem. "In order to realize face recognition capabilities in front ends, a powerful ISP chip is required to acquire high-quality images and enable excellent image processing ability, low noise processing capability and image blur recovery. Professional artificial intelligence (AI) chips need to be embedded into the cameras as well in order to realize capabilities such as face features modeling, analysis

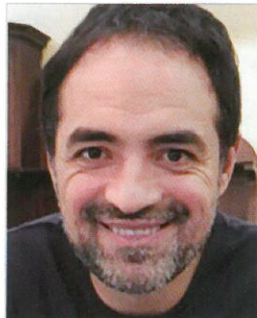
and comparison," Hu said.

"A camera with Intel processor and GPU with at least 8 GB RAM can run face recognition smoothly. This is the standard," said Vural. "Recently, Ayonix has developed 3D face recognition to run on Axis IP camera which has ARM-9 single core CPU in 32 bit. This has been a breakthrough to run a heavy process in a conventional IP camera."

"Since all modern algorithms are based on neural networks, it would make sense to have hardware acceleration for neural networks on the camera side. At the moment, I am aware of only one solution that can be embedded, which is the HiSilicon Kirin 970 chip with a neuromorphic processor. This is a cutting-edge device that was just released in 2017. And when they start making cameras with face recognition based on it, we can expect a noticeable step forward in this direction," said Ataev.



Karen Sangha, Field Marketing Manager, Security Solutions, Panasonic



Sadi Vural, President and CEO, Ayonix



Applying Deep Learning

Increasingly, facial recognition is using deep learning analytics to achieve further accuracy. In a similar vein, deep learning is applied to face recognition cameras

to enhance the recognition process.

Deep learning entails the computer extracting features by itself, with little to no manual intervention. The more features it extracts, including features that are hard to describe, the more accurate the recognition process becomes. That's why facial recognition engines are increasingly employing deep learning to improve accuracy.

"Over the past five years, AI technologies based on neural networks have almost completely overshadowed everything else. Face recognition has become much more reliable, especially in unfavorable conditions," Ataev said. "At the time being, AI and deep learning underlie all of the

most effective solutions on the market. These technologies beat classical algorithms in terms of recognition quality. And if you look at the speed at which they are evolving, no one would seriously consider applying classical algorithms."

"The core task in face recognition is to take an image of a face and convert it into a set of features. You want the features generated from two images of the same person to be as close as possible (regardless of lighting, expression and other distractions) while making sure that two images of different people produce significantly different features. Given enough data and computation, a neural net can simply do a better job of this than a hand-designed system. The network can end up

using features that are more complex and counterintuitive than a human designer is likely to consider," said Jamieson. "This change in technology allows newcomers to be very competitive in the face recognition market since accumulated institutional knowledge of previous techniques is less important."

And increasingly, vendors of facial recognition cameras have also put deep learning into their products. These include Hikvision's DeepinView Dual-Lens Face Recognition Camera and Dahua's 2 MP Starlight Face Recognition Box Network Camera, both embedded with deep learning functions.

"Some of the most direct benefits that deep learning algorithms can bring include achieving comparable or even better-than-human pattern recognition accuracy, strong anti-interference capabilities and the ability to classify and recognize thousands of features," Hong said. "With deep learning technology, the average accuracy of face recognition increases significantly — by 38 percent. Our advantages in artificial intelligence in security have come about by having our own excellent algorithm development team and using the most powerful GPUs in our computer platforms."

"Artificial intelligence algorithm is mainly to complete the face recognition and comparison of the entire process. Deep learning algorithm, based upon the training of big data, can improve the accuracy of face recognition, which then can be

applied in more complex environments, such as poorer image quality and wider angles," Hu said.

Current Challenges

Despite face recognition cameras' potential, several challenges still need to be overcome. One of them is the issue of privacy as the development of face recognition cameras will certainly infringe upon the personal privacy of the individuals being filmed. Therefore, for these cameras installed around certain premises to collect data, there should be a proper management mechanism. Information other than facial data should not be transmitted to the backend so as to remove the user's privacy concerns.

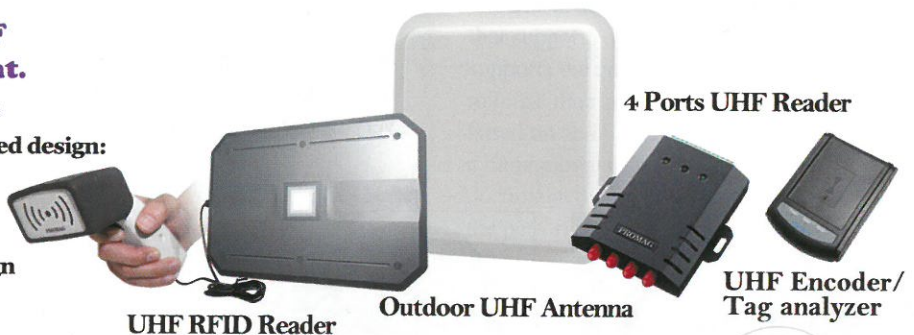
Also, market acceptance has yet to pick up given these cameras are at their beginning stage, and users are still taking a wait-and-see attitude. "I think the following factors may cause hesitance of customers when buying a face recognition camera: high cost, complicated parameter configuration and demanding installation process," Hu said. "We have corresponding solutions, namely developing different series of products to meet the needs of different projects, simplifying the client configuration process, trying to make its products simple and easy to use, and delivering user guide for its customers." **RWS**



UHF New Series from 860 - 960 MHz

We help to simplify your UHF application in all environment.

- ✓ 0.5W/1W UHF read/write modules
- ✓ UHF antenna OEM/ODM customized design:
 - Patch Antenna
 - Array Antenna
 - Ceramics Antenna
 - Chip Antenna
 - Paper Antenna
- ✓ UHF project consultation and design
- ✓ SDK/API available



GIGA-TMS INC.
Quality, Delivery & Service
Tel: 886-2-26954214

8F No. 31 Lane 169, Kang Ning Street,
Hsi Chih Dist, New Taipei City Taiwan

<http://www.gigatms.com.tw/>
Email: promag@gigatms.com.tw

GIGA-TMS INC. © 2018 All Rights Reserved.

