
IPC Privacy Protection Technology White Paper

White Paper by Dahua Technology



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1 Foreword

The European Parliament passed the **General Data Protection Regulations** (hereinafter referred to as the **GDPR**) in 2016, which formally took effect in the EU Member States in 2018. The GDPR is widely applicable to all institutions and organizations involved in the collection, transmission, reservation or processing of personal information in the EU Member States.

To realize effective target monitoring to crack down on crimes and guarantee security, and follow laws of different countries and regions to effectively protect personal privacy and interests, Dahua develops a smart surveillance camera with the privacy protection function. Apart from the basic monitoring function, it can effectively recognize faces or bodies in the surveillance images and blur relevant areas to protect personal privacy. It can also recover original images to restore the scene when an accident occurs or if necessary, with authorization.

With in-depth implementation of the GDPR and increasing emphasis on the protection of personal privacy, demands for cameras with privacy protection function will boost.

2 Principle of Dahua Privacy Protection

2.1 Target Detection Algorithm Based on Deep Learning

The target detection is designed to locate all the needed targets in an image and confirm their locations and sizes. Due to different objects with different appearances, shapes, poses, as well as lighting disturbance and object occlusion, target detection has been the most challenging problem in the machine vision field. Based on long-term accumulation of massive training data, Dahua self-developed smart detection algorithm has a unique advantage in the detection of targets such as faces, human bodies, motor vehicles, non-motor vehicles. Dahua provides the privacy protection function based on its self-developed face and human body detection algorithms. With its leading position in reliability, accuracy, and detection speed, it guarantees the occlusion effect on faces and human bodies.

The detection targets and parameters of the Dahua privacy protection function:

- Human body and the coordinates of its position.
- Face and the coordinates of its position.

Dahua privacy protection technology realizes target occlusion by using mosaic corresponding to the size of the face or human body detected by the deep learning algorithm. It can prevent the targets from being clearly identified and allow users to see their general appearance. After authorization is obtained, the original face and human body images can be completely recovered through the image recovery technology.

2.2 Stream Recovery Technology

The stream recovery technology is another self-developed key technology of Dahua. As the basis for personal privacy not being arbitrarily used, it ensures the effective application of the privacy protection function in the security field. It also serves as technical guarantee for evidence acquisition from video surveillance. Stream recovery refers to an image recovery technology wherein the required image information is hidden in the encoding phase and then extracted in the decoding phase according to the authorization from specific information processing technology.

Figure 1 below shows the encoding process of recoverable streams. According to the result of the algorithm detection, the information to be recovered will be calculated from the original image. Then overlapping mosaics will be added to generate the image with privacy protection. Lastly the mosaic images and the recovered information are compressed and integrated, with the output stream complying with the H264/H265 standards. On a back-end player which is unauthorized or does not support the recovery technology, the output stream is consistent and compatible with the ordinary stream.

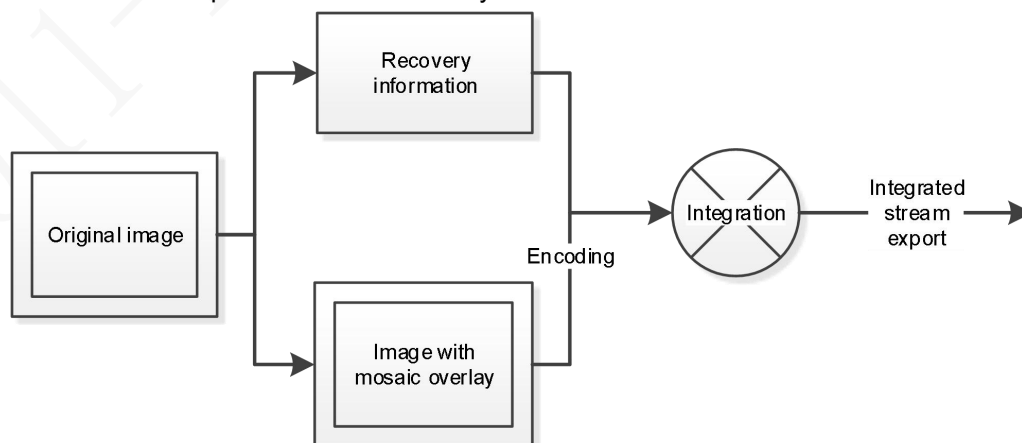


Figure 1 The encoding process of recoverable streams

After the back-end device receives the stream with its recovered information, the disintegration algorithm can be used to get the recovered information and the mosaic images (see Figure 2). If the user is not authorized or the terminal does not support the recovery technology, mosaic images through the decoder can be exported and displayed. If the user is authorized and the terminal supports the recovery technology, the recovered information will be extracted and restored to mosaic images to get the original images.

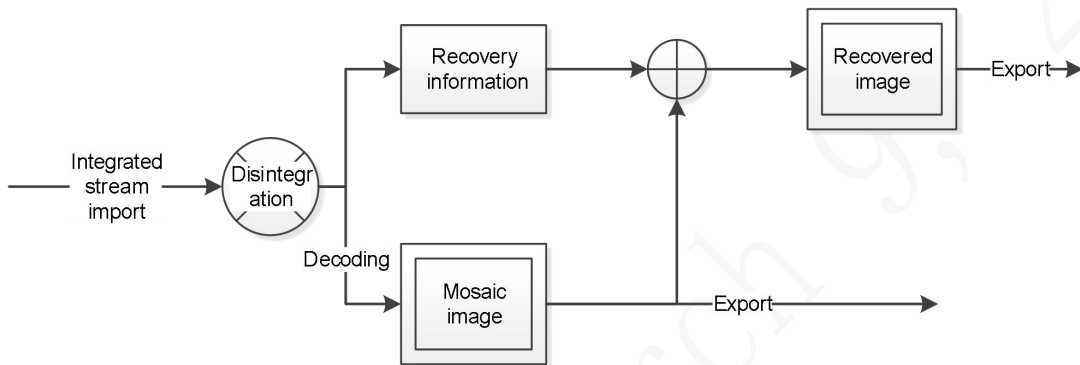


Figure 2 The decoding process of recoverable streams

2.3 Business Process of Dahua Privacy Protection

The privacy protection business refers to the detection of human or other protected targets in images, and application of security mosaic on the corresponding position to make the targets unrecognizable. At the same time, if authorized, the images without mosaic overlay can be recovered.

The front-end camera detects targets and their locations on the collected YUV images. The recovered information will be generated by using the original images according to the detection results. Mosaic will then be added on the original images, which can be exported through encoding (see Figure 3).

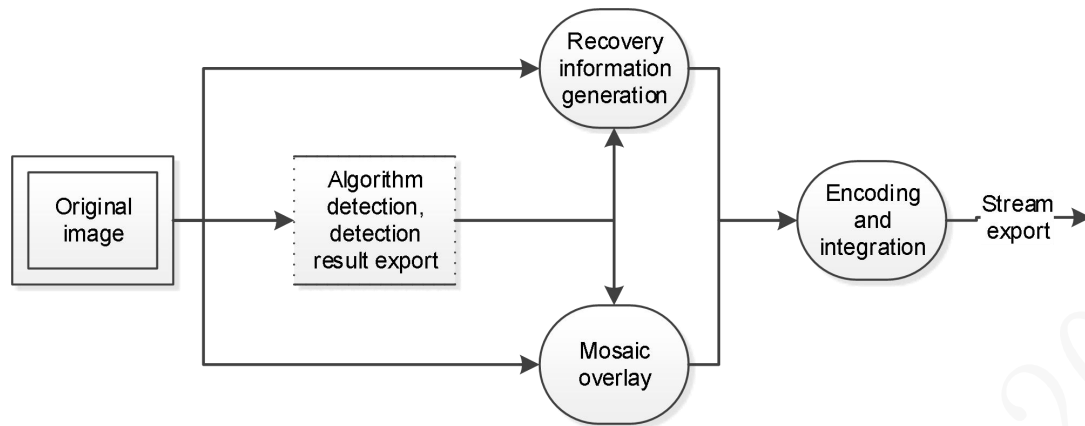


Figure 3 The business process of Dahua privacy protection

3 Highlights of Dahua Privacy Protection Technology

3.1 Face and Body Dual Detection Technology

The common face detection algorithm based on deep learning has a low detection rate for small faces at a far distance or faces in a large scene because the pixels are not high enough. The detection of side faces and faces of people with their back towards the camera is also low due to training set. To solve it, Dahua integrates the dual detection algorithm for faces and human bodies. For small faces, side faces and faces of people with their back towards the camera which can not be detected by the face algorithm, the occlusion area can be estimated according to the result of the human body detection. For detectable faces, mosaic is directly overlaid on the output area of the detection result. This does not only improve the occlusion rate of the privacy area in an image, but also makes the occlusion area of front faces nearby very accurate.



Figure 4 distant face mosaics through human body detection

In the large background shown in Figure 4, the pixel proportion of distant human faces is small, making the face detection algorithm inaccurate. As a result, they cannot be accurately masked. After using the body detection algorithm, all the targets are masked and the occlusion rate is largely enhanced.

3.2 Dahua Stream Recovery Technology

As mentioned above, the stream recovery technology is not only a self-developed key technology of Dahua, it is also capable of realizing privacy protection. For the front-end camera, the key steps include:

- 1) Extract the recovered information.
- 2) Overlay mosaic: Dahua mosaic overlay algorithm supports overlay of multiple target areas at the same time and all streams overlay.
- 3) Integrate the codes: The stream exported by the code integration algorithm satisfies the H264/H265 standards. For back-end device that does not support recovery

function, the video images with mosaic can also be normally decoded.



Figure 5 The image on the left is one not recovered and the image on the right is the one overlapped with the recovered information

3.3 Mosaic Technology with Variable Sizes

The privacy protection function is mainly used to protect the targets from being identified. However, for large targets, if the same target in different sizes is overlapped by a mosaic of the same size, the occlusion effect will be poor, making it easy for targets to be identified. Overlaying large mosaic might cause loss of the figure information and poor visual effect for small targets. Therefore, larger targets require larger mosaic while smaller targets require smaller ones.

For this reason, Dahua invented the mosaic technology with multilevel block sizes. The block sizes can be automatically computed according to the target size so that the target can be better protected from being identified. In Figure 6, the large target on the left has a larger mosaic block size than the smaller target on the upper right, and the overall effect seems be harmonious.



Figure 6 Mosaic technology with multilevel block sizes

4 Summary

Dahua smart cameras with the privacy protection function can export images with mosaic faces and human bodies to protect personal privacy. When necessary, the original images can be restored on site, making it convenient for administrator to check and analyze afterwards. Dahua privacy protection cameras do not only realize the purpose of normal security surveillance, but also satisfy the requirements of the GDPR for the protection of personal privacy, which will help contribute to the development of smart and safe city.