

# Product Manual

## Bullet Facial Capture & Identification Camera

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Version: 1.0.3

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Applicable model: FC710, FI710

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The product described in this manual is for sale and use in overseas only.

Photographs, graphics, diagrams, and illustrations provided in the manual are for reference only.

## Release history

Date	Version	Change
2018/9/18	V1.0	New release version
2018/11/15	V1.0.3	1. Lens parameters in the section of conformity product specification adjustment 2. Section 1 Adding FI710 can start the function of grabbing and comparing at the same time.

## Contacts

Email: [sales@zkteco.com](mailto:sales@zkteco.com)

For additional offices around the world, see [www.zkteco.com](http://www.zkteco.com) corporate offices.

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# 1 Product positioning and characteristics

## 1.1 Product positioning

FC710/FI710 bullet face grabbing comparison has built-in high-performance artificial intelligence algorithm for camera, which has the functions of face detection and feature extraction. FI710 has the function of face comparison and retrieval (capture and comparison can be opened at the same time), and supports the management of face images of 20,000 people. This series of guns are located in the monitoring sites where the illumination ranges of underground garage, warehouse and office area vary greatly at low illumination. FI710 can also be used for outdoor monitoring of urban roads and residential environment.

## 1.2 Product characteristics

FC710/FI710 bullet face capture comparison camera packages the face recognition algorithm highly abstractly, combines and fully utilizes the computing power of dedicated chips, and achieves the industry-leading level in recognition effect and practicability of the algorithm; its excellent capture comparison performance makes face video surveillance to a new level. It can be easily applied to a variety of application scenarios.

### 1.2.1 Recognition ability

- **High accuracy of recognition**

Professional in-depth learning of face model embedded server level, the capture rate under low-density crowd is more than 99%.

Face image 1:N target search, Top 1 similar results accuracy is more than 96%.

- **Recognition and anti-jamming**

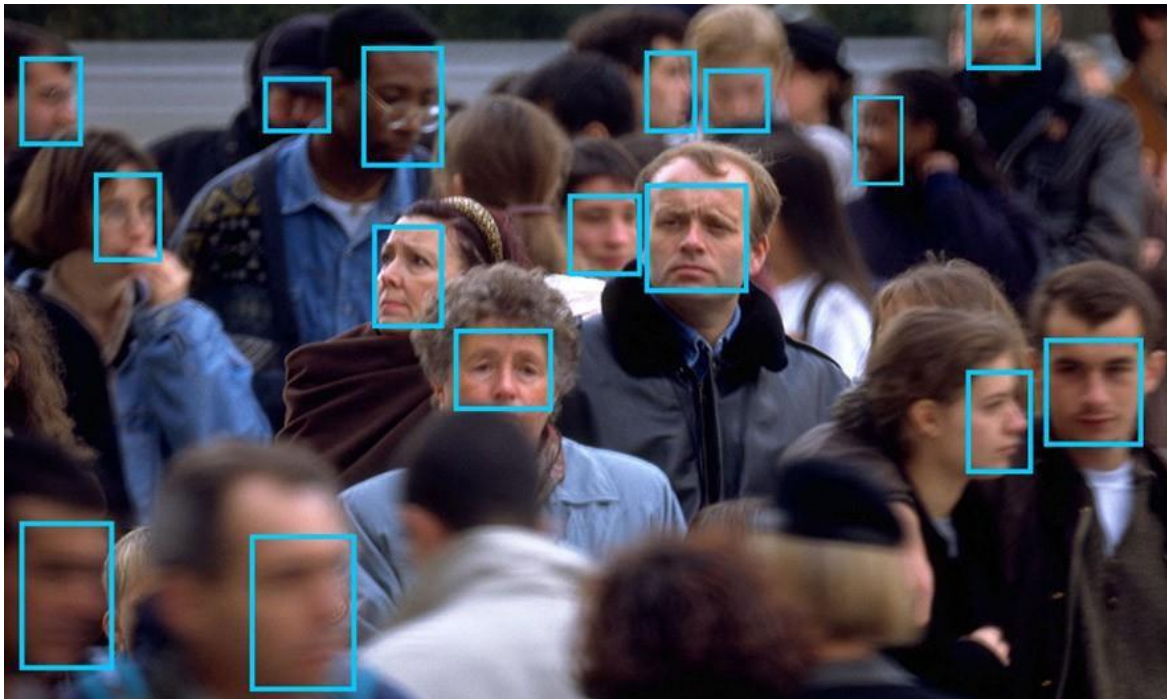
According to the face posture, size, clarity, degree of occlusion (masks, glasses, scarves, etc.), multi-dimensional face quality judgment, comprehensive evaluation of each face quality, capture the best photos.

- **Multi scene adaptation**

Support a variety of algorithmic models to adapt to different application scenarios.

- **Fuzzy image recognition**

Support low resolution, dark light, side face, bow, partial occlusion and other situations of face screenshots.



## 1.2.2 Processing performance

- **Extreme speed search**

Snapshot: It takes less than 100 milliseconds to detect and track faces from video.

Comparisons: Face comparison search of 20000 target library returns the results of the comparison at sub-second level.

### 1.2.3 Deployment capability

Fast and convenient, using WEB style to configure software parameters, IP address configuration can be used to run with default parameters.

### 1.2.4 Interface development

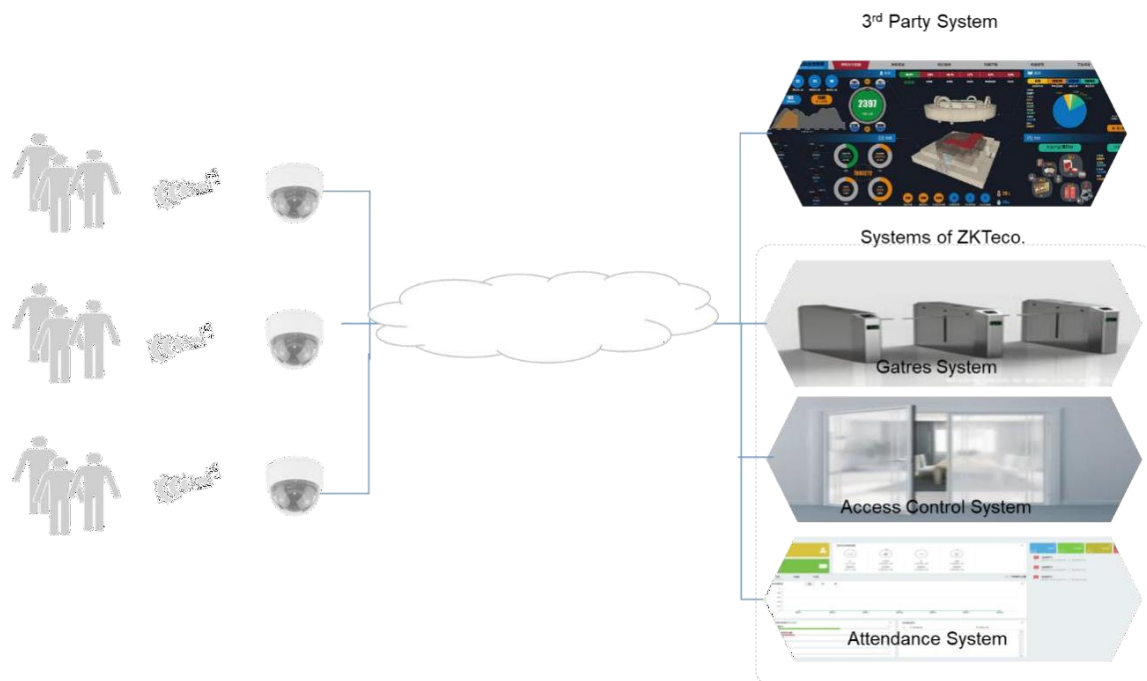
The shared library of Linux/Windows platform is provided, and the third party can use API interface to develop the application conveniently.

## 2 Typical application scenarios

FC710/FI710 can be connected with central control access control, attendance and gate system. It completes the capture/comparison of face images, and reports the results of the capture and comparison to the entrance guard and gate system. The gate is completed by the entrance guard gate system, and the gate is opened, closed and alarmed. The results of comparison can also be reported to the attendance system, which completes the storage, analysis and summary of back-end data.

FC710/FI710 can also be connected with third party systems. The third party can use API interface to complete such intelligent visual tasks as capturing face extraction, image storage, image extraction, feature acquisition, face comparison and so on.





### 3 Product feature

#### 3.1 Management of Face Image Target Base

Applicable to Face Comparison

The function of creating, modifying, querying, emptying and deleting the object database of face image;

Fast inputting, querying and deleting face images in the target database;

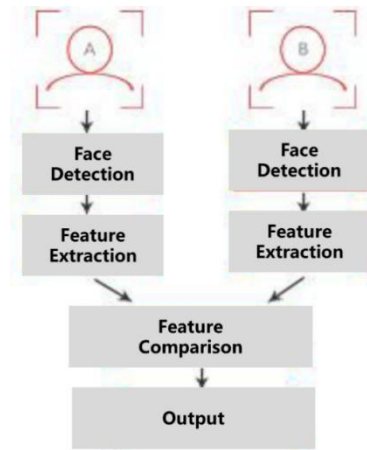
Face image features are quickly stored, deleted and queried. Face image detection and feature extraction

Face image detection function supports fast locating the face position in the image, returning a rectangular box to locate the face, and scoring the quality of the detected face.

Face detection function uses key point detection algorithm, which can accurately locate the key points of faces with various expressions, gestures and angles. This technology uses the latest cascade regression-based location algorithm, combines the five features calibration method based on in-depth learning, and integrates a variety of standard data sets to make Face detection. It has lower error rate and better adaptability, and ensures the accuracy of

feature extraction and comparison. Facial Image and Feature 1:1 Similarity Verification

Face image similarity verification compares the source image with the target image and outputs the similarity between them.



### 3.2 Face Image and Feature 1:N Search and Comparison

The function of face image and feature search and comparison compares the source image (or face feature) with the image (or feature) in the target database, and returns the result of comparison. Face Image Attribute Recognition

Face attribute recognition function can recognize many attributes of face, including age, gender and so on. Video analysis

#### 3.2.1 Analysis task management

Support the creation, deletion, modification and query of analysis tasks.

#### 3.2.2 Analysis result push

Video analysis automatically performs face tracking, de-duplication and matting. Results The alarm information was pushed and compared by API.

## 3.3 Streaming media service

### 3.3.1 Multiple Video Format Support

Mainstream RTSP, GB28181 and other real-time video streams are supported.

### 3.3.2 VOD support

It can output the video stream being analyzed in real time and encode the Face detection box into the video stream to facilitate users to view the current status of Video Analysis. Support blacklist and VIP management. Support blacklist library and VIP library settings and notification backstage after Face comparison hits.

### 3.3.3 Other feature

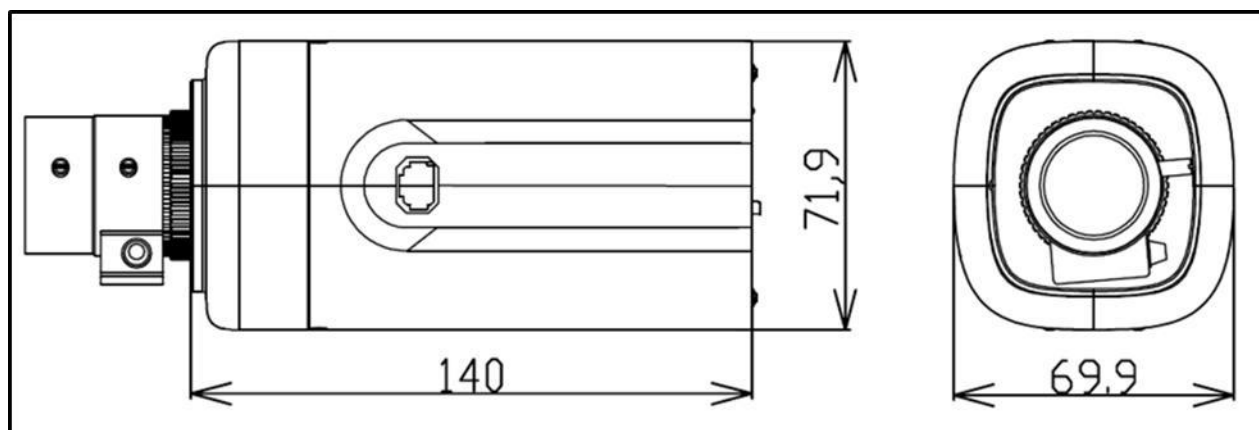
- The special acceleration chip is responsible for face capture and comparison. It adopts embedded operating system and high-performance hardware processing platform, which has high stability and reliability and meets the needs of diverse industries.
- Server-level Face Detection Comparing Algorithms
- Face tracking technology based on motion trend prediction has a capture rate of 99% and a repeat capture rate of no more than 10%.
- Full storage is supported. In addition to facial features, photos can also be stored.
- Supporting facial features, multi-stock photo storage
- Face Detection Capture: Minimum and Maximum Pixels for Face Detection can be set, and Detection Area can be set
- Support Face Tracking
- Picture Quality Screening: Optimal Face Picture Output
- Four capture modes: automatic, optimal, fast and customized, adapted to more scene applications

- Face Attributes: Support the output of face attributes such as gender and age detection
- Supports identifying record queries and searching database personnel according to query conditions.
- Using 1/1.8"(FI710), 1/2.8" (FC710) high-performance progressive scanning CMOS sensor, it still provides excellent image in low illumination environment.
- Superstar light level ultra-low illumination perception.
- Leading multi-stream technology, based on international advanced H.265/H.264 real-time coding algorithm, supports ONVIF, GB28181 and other bitstream and frame rate parameters, facilitates high-quality image transmission on narrowband, with the highest resolution of 1920\*1080@30fps.
- Supports three independent stream coding, including dual 1080P HD stream, and supports simultaneous 10-way stream fetching.
- 3A control (automatic white balance, automatic gain, automatic exposure control), face tracking exposure.
- Low-illumination electronic shutter, when in low-illumination environment, the shutter of network camera automatically slows down, by prolonging exposure time to obtain brighter, less noise image.
- Supporting ultra-wide dynamic function, the network camera automatically balances the brightest and darkest parts of the monitor screen, and enhances the dynamic range of the whole picture so as to see more details of the monitor screen.
- Support fog permeability function.ICR Automatic switch, Day and night monitoring, Low illumination enhanced.
- It supports low bit rate, low latency, ROI region of interest enhancement coding, SVC adaptive coding technology and 10M/100M adaptive

network ports. Reduce processing time, ensure useful image quality and save storage space.

- The network camera can be controlled by browser or client software, and the parameters of the network camera can be set.
- Support video occlusion detection, IP address conflict, MAC conflict detection, abnormal automatic recovery function, network interrupt automatic connection function.
- Supports Face Detection snapping, intermittent transmission, detection, pre-recording and disappearance of detection alarm videos and retrieval.
- Video Video Recording: Timing Video, Face Detection Alarm Video, Alarm Video (Face Detection Alarm, Recognition Alarm).
- Capture rate, full frame rate, full frame Face Detection capture efficiency, high front face rate, multi-dimensional face quality judgment, low face repetition rate. For each face quality comprehensive score, it provides a variety of face capture mode and push map mode to reduce invalid faces.
- Multilevel User Rights Management (FC710 Level 3, FI710 Level 2) supports authorized users and passwords. The system administrator manages multiple different users and configures different privileges for each user.
- Supports SD/SDHC card mode to store alarm high-definition pictures (FI710 only).
- Supports the installation methods of suction top, embedded and bracket.

## 4 Appearance structure



FC710/FI710

## 5 Installation and operation

For the complete hardware installation and software settings of FC710/FI710 face capture comparison camera, please refer to the Installation Instructions of FC710/FI710 Face capture comparison camera and the Configuration Instructions of FC710/FI710 Face capture comparison camera.

## 6 Specifications and parameters

Product type	FI710	FC710
Camera		
image sensor	1/1.8 "2-megapixel progressive scanning CMOS	1/2.8 "2-megapixel progressive scanning CMOS
Effective image size	1920*1080	1920*1080
Minimum illumination	0.001IUX@F1.0	0.001IUX@F1.0
Day&Night	Automatic/color/black-and-white (ICR infrared cut-off filter)	Automatic/color/black-and-white (ICR infrared cut-off filter)

WDR	120dB	106dB
White balance	Automatic / manual	Automatic / manual
Strong light suppression	Support	Support
Electronic fog penetration	Automatic / manual / close	Automatic / manual / close
Digital noise reduction	Supporting Intelligent Adaptive 2D/3D Noise Reduction	Supporting Intelligent Adaptive 2D/3D Noise Reduction
Lens & fill light		
Focus	12-70mm/4-18mm	5-50mm
Maximum Aperture	F1.4/F1.6	F1.4
Aperture Type	DC-Iris	Manual
Function		
Video compression format	H.265/H.264/MJPEG	H.265/H.264/MJPEG
Coding type	H.265 : MP, H.264: HP/MP/LP	H.265 : MP, H.264: HP/MP/LP
Maximum resolution	1920×1080(1080P)	1920×1080(1080P)
Video coding frame rate	Supporting simultaneous output of three bitstreams:  50Hz : 25fps(1920*1080,1280*720,1920*1080)  60Hz : 30fps(1920*1080,1280*720,1920*1080)	Supporting simultaneous output of three bitstreams:  50Hz : 25fps(1920*1080,1280*720,1920*1080)  60Hz : 30fps(1920*1080,1280*720,1920*1080)

Multi stream	Supports three-bit stream technology, dual HD, and simultaneous 10-way access.	Supports three-bit stream technology, dual HD, and simultaneous six-way access.
Front end access protocol	ONVIF,GB/T28181	ONVIF,GB/T28181
Network protocol	TCP/IP,HTTP,HTTPS,FTP,DHCP,DNS,DDNS,RTP,RTSP,RTCP,PPPoE,NTP,802.1X,IPv6	TCP/IP,HTTP,HTTPS,FTP,DHCP,DNS,DDNS,RTP,RTSP,RTCP,PPPoE,NTP,802.1X,IPv6
OSD superposition	Supporting 200*200 BMP 24-bit image overlay, optional overlay location; Overlay time, place, week, device number information and 6 custom letters Up to 8 regions are supported, and the overlay position can be set. Vector and dot matrix font library support	Supporting 200*200 BMP 24-bit image overlay, optional overlay location; Overlay time, place, week, device number information and 6 custom letters Up to 8 regions are supported, and the overlay position can be set. Vector and dot matrix font library support
Alarm linkage	Alarm Source: Mobile Detection Alarm/Occlusion Alarm/Switch Input/Intelligent Analysis Alarm Linkage Target: Switch Output/Preset Position/Cruise Trajectory/Scan/Mail Send/Pre-alarm Preview	Alarm Source: Mobile Detection Alarm/Occlusion Alarm/Switch Input/Intelligent Analysis Alarm Linkage Target: Switch Output/Preset Position/Cruise Trajectory/Scan/Mail Send/Pre-alarm Preview
Intelligent analysis		
Anomaly detection	Face detection, video occlusion, motion detection, network disconnection, IP address impulse	Face detection, video occlusion, motion detection, network disconnection, IP address impulse
Professional intelligence		

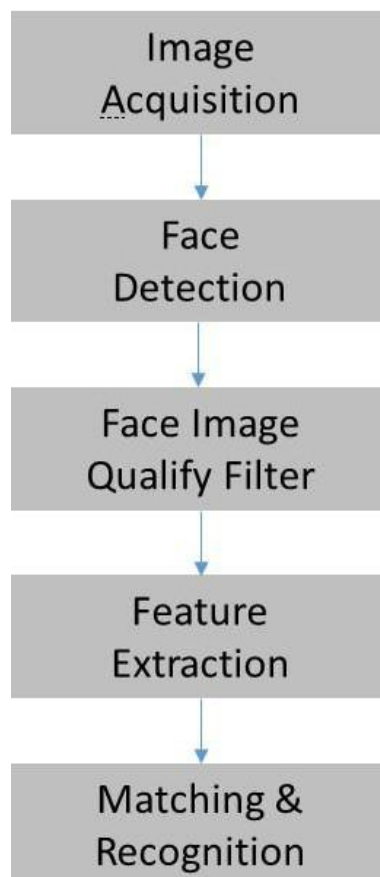


Face detection	Support dynamic Face detection, tracking, optimization, output face optimal capture. Simultaneous detection of 50 persons	Support dynamic Face detection, tracking, optimization, output face optimal capture. Simultaneous detection of 50 persons
Face comparison	Supports 20,000 people of the largest base library, supports the front-end storage, and realizes the recognition and comparison of the front-end.	
Face area exposure	Real-time adjustment of exposure parameters according to ambient light conditions to optimize face capture quality	Real-time adjustment of exposure parameters according to ambient light conditions to optimize face capture quality
Interface		
Internet Interface	1 RJ45 100 MHz Ethernet port supports 10M/100M self-adaptation.	1 RJ45 100 MHz Ethernet port supports 10M/100M self-adaptation.
Communication serial port	1 half duplex RS-485 interface	
Alarm interface	2-way alarm input and 1-way alarm output	
Audio Interface	1 channel audio input and 1 channel audio output	
Storage interface	Provide a MicroSD card slot, support MicroSDHC/MicroSDXC, support a maximum capacity of 256GB memory card	
General specification		
Power	DC12V±20%	DC12V±20%
Consumption	7W	6W

Working temperature / humidity	0~45℃; 5%~95% (non-condensing)	0~45℃; 5%~95% (non-condensing)
Lightning protection rating	6kV lightning protection and surge prevention	6kV lightning protection and surge prevention
Weight	0.49 kg	0.44 kg
Size	140mm*71.9mm*69.6mm	140mm*71.9mm*69.6mm

## 7 Note A: Introduction to Face Detection and Recognition

Generally speaking, Face Recognition includes several links: image acquisition, Face detection, screening and extraction of high-quality face images, face feature extraction, matching the detected face with the face database (existing identity information) to obtain the corresponding personal identity information of the face (in the database, not in the database, in the database). Information such as name, identity number, etc.



- A. Based on the principle of optical imaging, the original image data collected by image sensor is processed by ISP image signal processing, and a video image sequence with good quality and without over-compression loss is obtained.
- B. To detect the face that meets the detection criteria in the screen, we get the results of face position coordinate value (the size of the box where the face is framed), face angle (Pitch, yaw, roll angle Roll), blur (Blur) and simple key points (Landmark eyebrow, eye, nose, lip, etc.) calibration calculation.
- C. Through the comprehensive evaluation of different quality dimensions (face size, ambiguity, angle, occlusion, etc.), the quality of face images is filtered, and the image results that meet the recognition conditions are screened out.
- D. Face feature extraction (a good algorithm has high similarity of "close distance" for the same person's features in a sense, but low similarity of "long distance" for different people's features. It should be noted that the features extracted from different algorithm models can not be mixed up, and the key points (Landmark, tens or even more than 100 points representing face features) calibration calculation, etc.
- E. Computing the matching ratio of 1:1 or 1:N to get the similarity score of distance and distance. When the score exceeds the set threshold, the validation or recognition pass is considered to be the same person at 1:1 and the existence of that person in the library at 1:N.

These links can be deployed integratively or distributed. The integrated deployment on the camera is the face capture and comparison camera, and the deployment on the server (which gets video stream from the general network camera) is the dynamic face capture and comparison server. Distributed deployment usually places the feature comparison part in the server, the other part in the camera, the corresponding server is the static Face comparison server, the corresponding camera is the face capture camera. Dynamic snapshot comparison servers can use the stock cameras, but the original network cameras monitoring the emphasis of large scenes (wide field of vision, the overall behavior of individuals or groups) and face analysis and comparison of micro scenes (small angle, clear face) are different, and many cameras are clear, the effect is not very ideal. New deployment systems usually have camera facial capturing capabilities. Face comparisons are placed on cameras or back-end servers depending on the size of the scene. There are two key points in face capture and comparison: the advantages and disadvantages of front-end face images; the advantages and disadvantages of

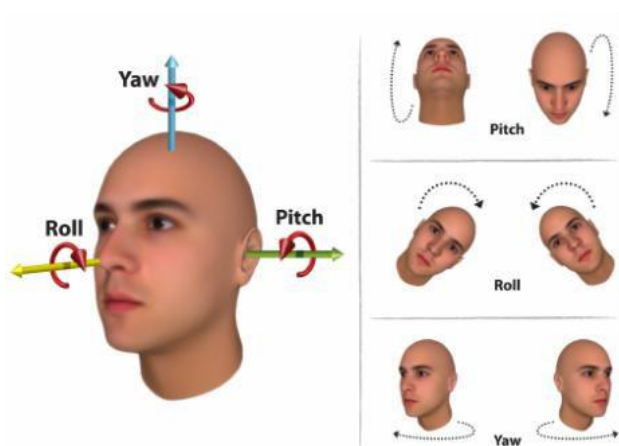
the second face extraction and Face comparison algorithm.

### 7.1.1 Principles for Installation of Cameras

Face detection recognition algorithms are usually trained based on certain face samples. Different algorithms depend on different samples. Sample quality, including the angle, size and ambiguity of the face, is different, which leads to the inconsistency of the adaptability of the trained algorithm. However, the general algorithm has better performance on the face with clear front when the size is appropriate. A good picture is better than a top-notch algorithm. If it is not properly installed, the face is too small, blurred, and the angle is too large, the speed and accuracy of Face Detection recognition will be affected.

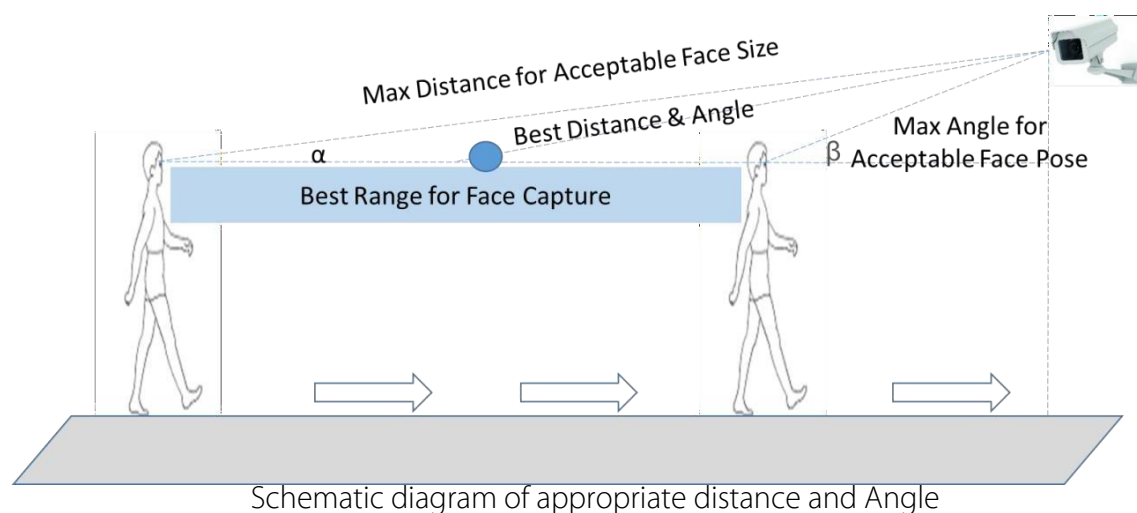
The key to installing the camera is to balance the size and angle of the face.

Face size: Conventional algorithms can recognize  $100 * 100$  pixels of face well, excellent algorithms can achieve  $80 * 80$  pixels or even lower. From the engineering point of view, it is more appropriate to define the lower limit of the acquired face pixels at  $90 * 90$  or even  $100 * 100$  (most back-end algorithms perform well and do not degrade significantly). Angle control: 3D pose is described by pitch angle Pitch, yaw angle Yaw and roll angle Roll as follows:

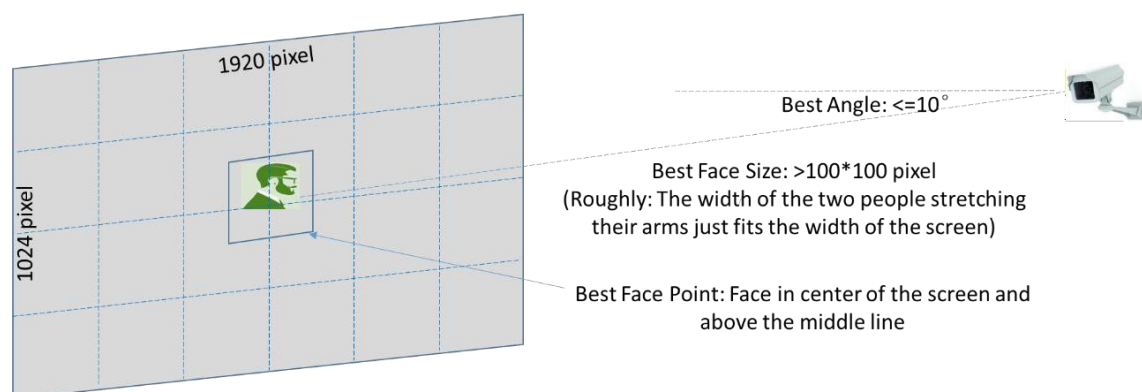


The best angle for a single person is undoubtedly  $[0,0,0]$ , that is, to look

straight ahead, similar to the perspective of identity photography. However, the camera usually hangs high, mainly affecting the pitch angle. When the best 100\*100 pixel face, its angle of view should not exceed 15 degrees. In the following figure, if the person is too far away from the camera (equivalent to the angle of view less than  $\alpha$ ), the obtained face pixels are too low to meet the requirements; if the person is too close to the camera and the angle of view is larger than  $\beta$  (15 degrees is better, the maximum is not more than 30 degrees), the obtained angle of the person is too large and does not meet the requirements. In addition, if the scene needs to consider multi-person occlusion, too low camera will lead to occlusion before and after people, depending on the scene, usually 2.2m or above.



## 7.12 Design capture core area



Sketch of Face Position on Screen at Optimum Imaging Point Distance Angle

In engineering design, according to the monitoring distance, the image face size is 100\*100, which can roughly calculate the required lens:

Shot Selection Quick Calculator

Recognition distance	Focal length	Sketch Map
2-4m	6.0mm	
3-5m	8.0mm	
4-8m	12mm	
6-11m	16mm	
10-18m	25mm	
16-28m	35mm	
25-40m	60mm	
42-58m	80mm	
60-80m	120mm	

If the camera is installed 6 meters away from the recognition area, the look-up table shows that the focal length of the lens should be selected as a 12 mm fixed focus lens or a zoom lens containing 12 mm.

The calculation formula is as follows:  $L = 3.5 / 2 / \tan(\frac{\theta}{2})$

L is the longest recognition distance and the  $\theta$  angle in the lens specification. 3.5 (m) is the recognition width.

The above is only a very elementary principle, specific to specific scenes, specific models of cameras, please follow the corresponding installation manual height and pitch requirements, distance installation of cameras. It is better to capture the camera facing the pedestrian passage, doorway and other larger probability can capture the scene of the front face. Avoid direct light camera.

In the case of good illumination, as long as the focal length is adjusted properly, the face taken by the camera installed in accordance with the above principles can be used for comparison with quality assurance.

### 7.13 Improvement of Capturing Effect by Debugging Image Parameters

Other influencing factors are the quality of the image itself, such as whether there are strong backlighting, high width dynamic, low illumination leading to large noise, image blurring and other abnormal scenes. The corresponding switch can be turned on. The following is a reference for image tuning. The final effect needs to be adjusted flexibly according to the specific scene settings.

A. Face exposure options can be turned on to optimize for scenes with large changes in brightness, darkness or over-brightness. (For example, FI710, Web

Configuration - Video Management - Image Parameters - Check Face Exposure in Photometric Mode.)

B. For wide dynamic scenes, camera image parameters can be set. (For example, FI710, web configuration-video management-image parameters-scenario parameters, can adjust the effect of wide dynamic. Wide dynamic can be smeared in certain scenarios. Please pay attention to the observation effect after adjusting parameters.)For low-light dark scenes, in order to achieve better face capture effect, it is suggested to add supplementary light, so that the illumination of the face can reach about 100 Lux. (For example, FI710, the web tries to adjust the exposure mode in configuration-video management-image parameters-shutter settings to manual 1/100 and automatic gain range to maximum 100, which is also helpful for low-light scenarios.)

Other adjustable parameters, such as brightness, contrast and 3D noise reduction, will be helpful for some less sharp or dark scenes. (For example, FI710, Web Configuration - Video Management - Image Parameters - General Settings)

Choosing backlight compensation or strong light suppression is helpful for backlight or strong light scene. (e.g. FI710, web configuration-video management-image parameters-photometry mode).

## 7.2 Face detection

Face detection is the process of detecting faces from images. Its measure index has capture rate (no leakage), repetition rate (no weight), false detection rate (good), high quality capture rate (good), capture delay (fast) and so on.

Its output generally includes the position of the face in the picture (the box coordinate array of the face frame), and the captured face picture. Some algorithms can also output advanced functions such as face angle (Pitch, Yaw, Roll), landmark, ambiguity and occlusion.

In the same algorithm, the performance of these indicators is different in different scenarios. To synthesize according to customer scenarios, it is not as simple as the smaller the better. For example, the face is too small to be recognized. Setting the parameters of face size to be detected very low can greatly improve the detection index, but it is not helpful to complete the

system of face identification. It is an incremental comparison. From the perspective of E2E system, it is meaningful and comparable to set the lower limit of face quality such as large enough pixels and small enough angle of face.

Different application scenarios also require the ability of Face Detection: some scenarios, such as access control, require high real-time performance, and face quality can meet the standard; some scenarios, such as monitoring, need periodic scanning, face needs periodic extraction; some scenarios, such as VIP care, require high quality of face, but the timeliness is not so good. Strong. The algorithm design is able to adapt to these scenarios, and has the ability to customize the detection mode according to the special needs of customers.

In order to reduce the backend burden and duplicate push, the detection algorithm should have a certain ability of weight removal. In low real-time scenarios, the highest quality photos are cached and iterated repeatedly until the time threshold reaches or leaves the camera (a certain time) before pushing the acquired optimal face.

For example, FI710 camera has automatic timing, optimal mapping, fast, customized several modes for customers to choose. The simple mechanism of several modes is as follows. Refer to the configuration manual of each type of camera for specific product capabilities.

### **Automatic mode**

Under the premise of satisfying the boundary of Face detection, within the same Track, the best quality face in push capture interval ( $M = 80\text{ms}$ ,  $200\text{ms}$ ,  $500\text{ms}$ ,  $1\text{s}$ ,  $2\text{s}$ ,  $4\text{s}$ ); the total number of snapshots from a single face entering the detection area to leaving the detection area is less than or equal to three.

Suggested scenario: security deployment control class

Advantages: High capture rate. It is a real-time and optimal balancing



scheme.

Disadvantage: One person can snap multiple pictures, occupy more bandwidth, and have a high rate of repeated snapping.

### **Optimal mode**

The snapshot image is N images with the highest quality score within one Track. In this mode, real-time is not emphasized, and the best recognizable face image is uploaded to the back-end platform for use, and the unqualified snapshots are filtered out. When the recognition boundary filter is opened, the push snapshot image is filtered according to the identifiable boundary condition, and the overall snapshot image quality is higher after the opening, and there will be corresponding missed grabs. For example, a face Track in the picture does not appear foreface all the time, and if it does not meet the identifiable condition, it will be filtered out.

Suggested scenarios: security face control + new retail passenger flow statistical analysis / VIP recognition application

Advantages: Repeated snapping rate is low, and the quality of the map is the highest. Background does not need secondary filtering, but it can be used foolishly without repeated detection, directly do feature extraction and recognition comparison.

Disadvantage: In some cases, it can not meet the requirements of high real-time.

### **Fast mode**

It meets the requirement of higher real-time performance. When the face is detected, the image is released as soon as the recognizable boundary is reached; if the number of snapshots is set to 2, the second image is higher than the first one with 3 points, otherwise it will not be pushed. The third is the same.

Suggested scenarios: Weak cooperation of access control, VIP identification, attendance check-in and other scenarios.

Advantages: The front-end filters out face images that do not meet the recognition requirements, and the repetition rate is low. The quality of drawing is high.

Disadvantage: Miss catch rate will rise. It is not guaranteed to meet the requirement of the number of snapshots set.

### **Custom mode**

Open all parameters on the user interface. The captured image is the image that meets the quality filtering condition within the capture interval. If the threshold is set too high, it may miss the capture. Open minimum face pixel parameter input box setting: minimum 40\*40, in order to achieve better recognition and comparison effect, it is recommended to set more than 80\*80.

Advantages: Users set their own face image quality filtering conditions, flexibly respond to the needs of various scenarios.

## **7.3 Face attribute extraction**

Recognition of face age, gender and so on, some advanced algorithms can also extract whether occlusion, hats, glasses, beard and so on. Face comparison

1:1. After extracting the face feature values from the photos, the algorithm compares the similarity between the two faces by comparison, that is, how high the probability that the two faces are the same person.

1:N. After comparing the eigenvalue array of a person's face with the eigenvalue of the N person in the face database, we can get the results that the face has the highest similarity or the top several similarity scores in the database. According to the set threshold, we can judge whether the person exists in the face database or not.

N: N. Collision comparison is made between two face feature base libraries to see if there are faces with high similarity, that is, to judge which faces are the same in the two libraries.

Measure index:

Similarity score: A score used to represent the similarity of two faces, such as 0-100, the higher the score, the greater the likelihood of being the same person.

Similarity threshold: The higher the threshold is, the higher the accuracy will be. However, the noise may lead to the omission of "actual identical or similar" people. On the contrary, the lower the threshold, the more the recall rate is, and the more the number of results is.

However, it needs to be explained that the "off-scene chat threshold" is false. From a mathematical point of view, there are three conditions for setting the threshold:

A positive and negative sample ratio

B Positive Sample Pass Score

C Negative Sample Misrecognition Score Reduction

With these three values and the threshold curve of the algorithm itself, the threshold can be calculated in reverse.

**The concept of 1:N throughput is as follows:**

Positive Sample Set = Samples of Target Personnel in Base Library

Consciousness = first hit the bottom library and score higher than the threshold

Pass rate = number of positive samples / aggregate number of positive samples passed by the target person

**So the throughput is affected by the threshold.**

**The concept of 1:N error rate is as follows:**

Negative Sample Set = Samples that the target person is not in the base

Misunderstanding = the first person to hit the bottom bank, and the score is higher than the threshold.

Misrecognition rate = the number of negative samples passed by the target person mistakenly / the total number of negative samples

**So the throughput is affected by the threshold.**

**1:1 pass rate:**

Positive sample set = I compare myself

Consciousness = similarity score higher than threshold

Pass rate = number of positive samples / aggregate number of positive samples passed by the target person

**So the throughput is affected by the threshold.**

**1:1 misrecognition rate:**

Negative sample set = I compare myself with others

Misunderstanding = similarity score higher than threshold

Misrecognition rate = the number of negative samples passed by the target person mistakenly / the total number of negative samples

**So the error rate is also affected by the threshold.**

Comparison input:

1:1: Two sets of facial features to be compared

1:N: Face Feature Base Library, Face Feature to be compared

M: N: Two or more facial feature Libraries

Compare Output result:

1:1: If the similarity exceeds the threshold, it will pass, otherwise it will not pass.

1:N: One or more results whose similarity exceeds the threshold

## 7.4 Face recognition

### 7.4.1 Static identification

Input static pictures, compare with the face in the base database, and recognize the identity of the person through the identity information bound by the face in the base database.

### 7.4.2 Dynamic recognition

Face is extracted from the video and compared with the face in the base database. The identity of the person can be recognized by the identity information bound by the face in the base database.

### 7.4.3 liveness detection

Basic concepts: Through technical means, we can judge that the face extracted from video is a living face, not other non-living faces such as electronic screen photos, print photos, face masks, family models, etc.

Measure index: accuracy

Pass rate:  $\text{Pass rate} = \text{positive sample number} / \text{positive sample set}$ , positive sample set = face of real person; Pass rate is affected by threshold.

Error rate:  $\text{Error rate} = \text{negative sample number} / \text{negative sample set of real person}$ , negative sample set = face of non-real person (photo, mobile phone, etc.); Error rate is also affected by threshold value.

The main technologies are as follows. At present, there is no technology that can prevent all forgery means, and the cost is different. Customers should

judge whether they need live identification according to their actual situation.

Dual shot 3D in vivo recognition

Infrared Living Recognition: Reflectivity of human skin to specific infrared wavelengths is different from that of other substances

Single-shot RGB, Video analysis combined with command action

3D structured light

Single-camera RGB trained by in-depth learning algorithm can only prevent the electronic screen and print photos with specific materials, and can not resist attacks such as skin masks.

## 7.5 Face recognition measure index

- Face Base Database Size
- Recognition Response Speed
- Threshold: The lower the threshold, the higher the accuracy and error rate.
- Speed of warehousing
- Accuracy rate

### 7.5.1 Output result

Similarity score

One or more face results in the database above the threshold

Face attributes

## 8 Terms

The main acronyms involved in this document (in alphabetical order):

Abbreviations and English	Explanation
DNN	Deep Neural Network
CNN	Convolution Neural Network
RNN	Recurrent Neural Network
LSTM Network:	Long Short Term Memory Networks
Crowd density	The number of people entering and leaving the picture in one second. When defining scenarios, peak traffic density, such as in a subway station, may be 25 people/s during rush hours.
Visitors flowrate	The total number of people passing through a section of a line in one direction during a certain period of time
Passenger flow	It's the flow of customers and the people who want to buy. It is not equal to the flow of people, but a subset of the flow of people in the same scene.
FaceID	A person is a faceID, from birth to death.
FaceToken	The ID corresponding to a feature of a person's face image. A FaceID corresponds to multiple FaceTokens. Having FaceToken means that the face image passes the quality judgement.
ImageID	Unmatted Base Map ID
Track ID	One face tracking process corresponds to one Track ID. The application of Track ID can reduce the number of faces detected and improve the quality. If it breaks, a new Track ID will appear unless the face recognition and de-duplication technology is used. Its measurement index is track interruption rate = new Track number/total Track number after track break = single face snapshot number set to 1, repeated snapshot rate
Group ID	One face database corresponds to one group ID. The state of face database corresponds to inactivation and activation.

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ZK Building, Wuhe Road, Gangtou, Bantian, Buji Town,  
Longgang District, Shenzhen China 518129

Tel: +86 755-89602345

Fax: +86 755-89602394

[www.zkteco.com](http://www.zkteco.com)

