

DESCRIPTION

TARGET OBJECT IDENTIFICATION SYSTEM, METHOD AND APPARATUS, ELECTRONIC DEVICE AND STORAGE MEDIUM

Technical Field

The present disclosure relates to computer vision technologies, and in particular, to a target object identification system, method and apparatus, an electronic device and a storage medium.

Background

In recent years, with the continuous development of artificial intelligence technology, artificial intelligence technology has achieved relatively good results in computer vision, speech identification and other aspects. In some relatively special scenes (such as tabletop game scenes), due to the limitation of the field of vision and sharpness of the camera photographing, it is impossible to accurately identify and monitor the player's betting situation and the player's winning or losing situation.

Summary

The present disclosure provides a target object identification solution.

According to an aspect of the present disclosure, provided is a target object identification system, including a first image acquisition apparatus, a second image acquisition apparatus, and a processor, where: the first image acquisition apparatus is configured to collect an image of a first target region, the second image acquisition apparatus is configured to synchronously collect an image of a second target region, and the second target region includes part or all of the first target region; the resolution of the first image acquisition apparatus is higher than that of the second image acquisition apparatus, and the field of view of the second image acquisition apparatus is greater than that of the first image acquisition apparatus; the processor is configured to identify each first target object according to the image of the first target region, and identify each second target object according to the image of the second target region; and determine an association relationship between each first target object in the image of the first

target region and each second target object in the synchronously collected image of the second target region, where the first target object is each target object in the first target region, and the second target object is each target object in the second target region.

With reference to any embodiment provided by the present disclosure, the first target object includes a target object related to a game object, and the second target object includes a target object related to a player; the determining an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region includes: mapping the first target object to the image of the second target region according to a positional relationship between the first image acquisition apparatus and the second image acquisition apparatus to determine each corresponding mapped target object; and determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the player in the image of the second target region and the position of each mapped target object.

With reference to any embodiment provided by the present disclosure, the determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the player in the image of the second target region and the position of each mapped target object includes: if the distance between one target object related to the player and the target object mapped from one first target object is less than or equal to a first distance threshold, determining that the first target object is associated with the target object related to the player.

With reference to any embodiment provided by the present disclosure, the first target object includes a target object related to a game object, and the second target objects include a target object related to a game object and a target object related to a player; the determining an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region includes: obtaining a correspondence between each first target object and each target object related to the game object in the image of the second target region according to the positional

relationship between the first image acquisition apparatus and the second image acquisition apparatus; and determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the game object in the image of the second target region, the position of each target object related to the player in the image of the second target region, and the correspondence between each first target object and each target object related to the game object in the image of the second target region.

With reference to any embodiment provided by the present disclosure, the determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the game object in the image of the second target region, the position of each target object related to the player in the image of the second target region, and the correspondence between each first target object and each target object related to the game object in the image of the second target region includes: if the distance between one target object related to the player and one target object related to the game object in the image of the second target region is less than or equal to a second distance threshold, determining that the target object related to the player is associated with the first target object corresponding to the target object related to the game object.

With reference to any embodiment provided by the present disclosure, the target object related to the player includes a face;

the processor configured to determine the association relationship between each first target object and each target object related to the player, is configured to determine an association relationship between each first target object and each face; the processor is further configured to: obtain face keypoint information of each face in the image of the second target region; and determine identity information of a player corresponding to each face according to the face keypoint information; and associate each first target object with the identity information of each player according to the association relationship between each first target object and each face and the identity information of the player corresponding to each face.

With reference to any embodiment provided by the present disclosure, target objects related to the player include a face and a body; the processor configured to determine the association relationship between each first target object and each target object related to the player, is configured to determine an association relationship between each first target object and each body; the processor is further configured to: obtain face keypoint information of each face in the image of the second target region; determine, according to the face keypoint information, identity information of a player corresponding to each face; obtain body keypoint information of each body in the image of the second target region; determine a face associated with each body according to the face keypoint information of each face and the body keypoint information of each body; respectively determine identity information of a player corresponding to each body according to the identity information of the player corresponding to each face and the face associated with each body; and associate each first target object with the identity information of each player according to the association relationship between each first target object and each body and the identity information of the player corresponding to each body.

With reference to any embodiment provided by the present disclosure, target objects related to the player include a face and a hand;

the processor configured to determine the association relationship between each first target object and each target object related to the player, is configured to determine an association relationship between each first target object and each hand;

the processor is further configured to: obtain face keypoint information of each face in the image of the second target region; determine, according to the face keypoint information, identity information of a player corresponding to each face; determine a hand associated with each face according to the position of each face and the position of each hand in the image of the second target region; respectively determine identity information of a player corresponding to each hand according to the identity information of the player corresponding to each face in the image of the second target region and the hand associated with each face; and associate each first target object with the identity information of each player according to the association

relationship between each first target object and each hand and the identity information of the player corresponding to each hand.

With reference to any embodiment provided by the present disclosure, the determining a hand associated with each face according to the position of each face and the position of each hand in the image of the second target region includes: if the distance between the position of one face and the position of one hand in the image of the second target region is less than or equal to a third distance threshold, determining that the face is associated with the hand.

With reference to any embodiment provided by the present disclosure, target objects related to the player include a face, a body, and a hand; the processor configured to determine the association relationship between each first target object and each target object related to the player, is configured to determine an association relationship between each first target object and each hand; the processor is further configured to: obtain face keypoint information of each face in the image of the second target region; determine, according to the face keypoint information, identity information of a player corresponding to each face; obtain body keypoint information of each body in the image of the second target region; obtain hand keypoint information of each hand in the image of the second target region; determine a face associated with each body according to the face keypoint information of each face and the body keypoint information of each body; determine the identity information of the player corresponding to each body according to the identity information of the player corresponding to each face and the face associated with each body; determine a body associated with each hand according to the body keypoint information of each body and the hand keypoint information of each hand; determine the identity information of the player corresponding to each hand according to the identity information of the player corresponding to each body and the body associated with each hand; and associate each first target object with the identity information of each player according to the association relationship between each first target object and each hand and the identity information of the player corresponding to each hand.

With reference to any embodiment provided by the present disclosure, the determining a face associated with each body according to the face keypoint information of each face and the

body keypoint information of each body includes: if the area of an overlapping region between a region where face keypoints of one face are located and a region where body keypoints of one body are located is greater than or equal to a first area threshold, determining that the face is associated with the body.

With reference to any embodiment provided by the present disclosure, the determining a body associated with each hand according to the body keypoint information of each body and the hand keypoint information of each hand includes: if body keypoint information of one body and hand keypoint information of one hand satisfy a preset condition, determining that the body is associated with the hand.

With reference to any embodiment provided by the present disclosure, the preset condition includes at least one of the following: the area of an overlapping region between a region where body keypoints of one body are located and a region where hand keypoints of one hand are located is greater than or equal to a second area threshold; the distance between the region where body keypoints of one body are located and the region where hand keypoints of one hand are located is less than or equal to a fourth distance threshold; and an angle between a first connecting line of the body keypoint information of one body and a second connecting line of the hand keypoint information of one hand is less than or equal to an angle threshold, where the first connecting line is a connecting line between an elbow keypoint and a hand keypoint in the body keypoints of the body, and the second connecting line is a connecting line between hand keypoints corresponding to the hand.

According to an aspect of the present disclosure, provided is a target object identification method, including: identifying each first target object according to an image of a first target region, and identifying each second target object according to an image of a second target region, where the image of the first target region is collected by means of a first image acquisition apparatus, the image of the second target region is collected by means of a second image acquisition apparatus, and the second target region includes part or all of the first target region; the resolution of the first image acquisition apparatus is higher than that of the second image acquisition apparatus, and the field of view of the second image acquisition apparatus is

greater than that of the first image acquisition apparatus; and determining an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region, where the first target object is each target object in the first target region, and the second target object is each target object in the second target region.

According to an aspect of the present disclosure, the first target object includes a target object related to a game object, and the second target object includes a target object related to a player; the determining an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region includes: mapping the first target object to the image of the second target region according to a positional relationship between the first image acquisition apparatus and the second image acquisition apparatus to determine each corresponding mapped target object; and determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the player in the image of the second target region and the position of each mapped target object.

According to an aspect of the present disclosure, the determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the player in the image of the second target region and the position of each mapped target object includes: if the distance between one target object related to the player and the target object mapped from one first target object is less than or equal to a first distance threshold, determining that the first target object is associated with the target object related to the player.

According to an aspect of the present disclosure, the first target object includes a target object related to a game object, and the second target objects include a target object related to a game object and a target object related to a player; the determining an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region includes: obtaining a correspondence between each first target object and each target object related to the game

object in the image of the second target region according to the positional relationship between the first image acquisition apparatus and the second image acquisition apparatus; and determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the game object in the image of the second target region, the position of each target object related to the player in the image of the second target region, and the correspondence between each first target object and each target object related to the game object in the image of the second target region.

According to an aspect of the present disclosure, the determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the game object in the image of the second target region, the position of each target object related to the player in the image of the second target region, and the correspondence between each first target object and each target object related to the game object in the image of the second target region includes: if the distance between one target object related to the player and one target object related to the game object in the image of the second target region is less than or equal to a second distance threshold, determining that the target object related to the player is associated with the first target object corresponding to the target object related to the game object.

According to an aspect of the present disclosure, provided is a target object identification apparatus, including: an identifying unit, configured to identify each first target object according to an image of a first target region, and identify each second target object according to an image of a second target region, where the image of the first target region is collected by means of a first image acquisition apparatus, the image of the second target region is collected by means of a second image acquisition apparatus, and the second target region includes part or all of the first target region; the resolution of the first image acquisition apparatus is higher than that of the second image acquisition apparatus, and the field of view of the second image acquisition apparatus is greater than that of the first image acquisition apparatus; and a determining unit, configured to determine an association relationship between each first target object in the image of the first target region and each second target object in the synchronously

collected image of the second target region, where the first target object is each target object in the first target region, and the second target object is each target object in the second target region.

According to an aspect of the present disclosure, provided is an electronic device, including: a memory and a processor, where the memory is configured to store computer instructions run on the processor, and when the processor executes the computer instructions, the target object identification method according to any embodiment of the present disclosure is implemented.

According to an aspect of the present disclosure, provided is a computer-readable storage medium, having a computer program stored thereon, where when the program is executed by a processor, the target object identification method according to any embodiment of the present disclosure is implemented.

In the target object identification system, method and apparatus, the device and the storage medium according to one or more embodiments of the present disclosure, images of a first target region are collected by means of a first image acquisition apparatus, images of a second target region are collected by means of a second image acquisition apparatus, and the second target region includes part or all of the first target region, the field of view of the second image acquisition apparatus is greater than the field of view of the first image acquisition apparatus. That is, images of a large field of view (global) range are collected by means of the second image acquisition apparatus, images of a small field of view (focus region) range are collected by means of the first image acquisition apparatus, and because the resolution of the first image acquisition apparatus is higher than that of the second image acquisition apparatus, the images collected by the second image acquisition apparatus may better distinguish the original details. That is, the first image acquisition apparatus focuses on collecting images in a larger field of view, and the second image acquisition apparatus focuses on distinguishing the target objects in the key region (such as distinguishing the value and quantity of game chips, cash, etc.), and then each first target object in the image of the first target region is associated with each second target object in the synchronously collected image of the second target region, so that the target

object identification system takes into account the large field of vision and the high resolution of the image of the key region, thereby improving the identification accuracy and environmental robustness of the target object.

Brief Description of the Drawings

To illustrate one or more embodiments of the specification or the technical solutions in the prior art more clearly, the drawings used in the embodiments or the description of the prior art are briefly described below. It is obvious that the drawings in the following description are only some embodiments recited in one or more embodiments of the specification, and a person of ordinary skill in the art may obtain other drawings according to these drawings without involving any inventive effort.

FIG. 1 is a schematic diagram of a target object identification system provided by at least one embodiment of the present disclosure;

FIG. 2A is a schematic diagram of an image of a first target region collected by a first image acquisition apparatus in a target object identification system provided by at least one embodiment of the present disclosure;

FIG. 2B is a schematic diagram of an image of a second target region collected by a second image acquisition apparatus in a target object identification system provided by at least one embodiment of the present disclosure, where the image includes a mapped target object of the first target object in FIG. 2A;

FIG. 2C is a schematic diagram of an image of a second target region collected by a second image acquisition apparatus in a target object identification system provided by at least one embodiment of the present disclosure, where the image includes a target object related to a game object;

FIG. 3A is a schematic diagram of body keypoint information in a target object identification system provided by at least one embodiment of the present disclosure;

FIG. 3B is a schematic diagram of hand keypoint information in a target object identification system provided by at least one embodiment of the present disclosure;

FIG. 4 is a flowchart of a target object identification method provided by at least one embodiment of the present disclosure;

FIG. 5 is a schematic structural diagram of a target object identification apparatus provided by at least one embodiment of the present disclosure; and

FIG. 6 is a schematic structural diagram of a target object identification device provided by at least one embodiment of the present disclosure.

Detailed Description

To make persons skilled in the art better understand the technical solutions in one or more embodiments of the specification, the technical solutions in one or more embodiments of the specification will be clearly and completely described below with reference to the accompanying drawings in one or more embodiments of the specification. It is apparent that the described embodiments are only part of the embodiments of the specification, rather than all the embodiments. All other embodiments obtained by a person of ordinary skill in the art based on one or more embodiments of the specification without involving any inventive effort fall within the scope of protection of the present disclosure.

At least one embodiment of the present disclosure provides a target object identification system. The target object identification system includes a first image acquisition apparatus, a second image acquisition apparatus, and a processor.

The first image acquisition apparatus is configured to collect an image of a first target region, the second image acquisition apparatus is configured to synchronously collect an image of a second target region, and the second target region includes part or all of the first target region. The image of the first target region and the image of the second target region may be a frame in a video stream, or may be an image obtained in real time, which is not limited in the present disclosure.

The resolution of the first image acquisition apparatus is higher than that of the second image acquisition apparatus, and the field of view of the second image acquisition apparatus is greater than that of the first image acquisition apparatus.

The processor implements identification of a target object by means of the following steps.

First, each first target object is identified based on the image of the first target region, and each second target object is identified based on the image of the second target region. Each first target object is each target object in the first target region, and the second target object is each target object in the second target region.

In order to improve the accuracy and precision of monitoring the first target object, and because the field of vision of the first target region is concentrated, a first image acquisition apparatus with a long focal length, a large pixel, and a high resolution may be adopted to collect the image of the first target region, so that an image of the first target region with high resolution, high color reduction, and large depth of field range may be obtained.

Because the field of vision of the second target region requires a high range, and the illumination of the game field is generally low, the apparatus that collects the image of the second target region has high requirements for low illumination capacity and high dynamic adaptability, and therefore, a second image acquisition apparatus with a short focal length, a small pixel and a medium resolution collects the image of the second target region.

Next, an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region is determined.

In the embodiments of the present disclosure, images of a first target region are collected by means of a first image acquisition apparatus, images of a second target region are collected by means of a second image acquisition apparatus, and the second target region includes part or all of the first target region, the field of view of the second image acquisition apparatus is greater than the field of view of the first image acquisition apparatus. That is, images of a large field of view (global) range are collected by means of the second image acquisition apparatus, images of a small field of view (focus region) range are collected by means of the first image acquisition apparatus, and because the resolution of the first image acquisition apparatus is higher than that of the second image acquisition apparatus, the images collected by the second image acquisition apparatus may better distinguish the original details. That is, the first image

acquisition apparatus focuses on collecting images in a larger field of view, and the second image acquisition apparatus focuses on distinguishing the target objects in the key region (such as distinguishing the value and quantity of game chips, cash, etc.), and then each first target object in the image of the first target region is associated with each second target object in the synchronously collected image of the second target region, so that the target object identification system takes into account the large field of vision and the high resolution of the image of the key region, thereby improving the identification accuracy and environmental robustness of the target object.

FIG. 1 shows a schematic diagram of a target object identification system according to at least one embodiment of the present disclosure. The system includes a first image acquisition apparatus, a second image acquisition apparatus, and a processor. The processor is not shown in FIG. 1. As shown in FIG. 1, the first image acquisition apparatus 111 is used for an image of a first target region. The image of the first target region may be an image of a game table. Each first target object identified based on the image of the first target region may be a target object related to the game object, for example, an exchanged object (such as a game chip), an exchange object (such as cash), a card and other items. The second image acquisition apparatus 112 is configured to synchronously collect an image of the second target region. The image of the second target region may be, for example, images of a game table and people around the game table, and each second target object identified based on the image of the second target region may be a player or a dealer.

The first image acquisition apparatus 111 and the second image acquisition apparatus 112 may be disposed adjacent to each other, and may perform image acquisition on the scene where image acquisition is required at any angle of view. For example, the two apparatuses perform image acquisition from a top view, or both perform image acquisition from a side view.

In a game scene, generally, the illumination of the game table region is high, while the illumination of the surroundings of the game table is low. Therefore, an image acquisition apparatus is used to simultaneously collect images of people at the game table area and around the game table. In this image, it is not possible to identify the details of the game-related target

of the game table, at the same time, to cover the players or dealers around the game table, and accurately identify the betting position, betting action, and betting player.

In some embodiments, a long focal length camera may be used to collect images of the first target region, and a short focal length camera may be used to collect images of the second target region, synchronously. The image of the first target region obtained by photographing the game table region by means of the long focal length camera has high resolution and color reproduction. Therefore, the details of the game-related target on the game table may be detected from the image of the first target region, such as details of exchanged objects, exchanges, and cards. The long focal length camera is used to photograph people at the game table region and around the game table, the field of vision is wide, and the low-illumination capability is high. Therefore, collecting images of the second target region by means of the long focal length, people and movements around the game table may be better identified. The combination of long and short focal length cameras solves the problems of insufficient density in the central hot zone and insufficient brightness in the surrounding hot zone when a single camera is used to collect images including the game table region and people.

In some embodiments, a small pixel-size camera may be used to collect the image of the first target region, and a large pixel-size camera may be used to simultaneously collect the image of the second target region. The image of the first target region obtained by photographing the game table region by means of the small pixel-size camera has high resolution and large depth of field range. Therefore, the details of the game-related target on the game table may be detected from the image of the first target region, such as details of the exchanged items, exchanges, and cards. The large pixel-size camera is used to photograph people at the game table region and around the game table. The field of vision is wide, and the low-illumination capacity is high. Therefore, the long focal length camera may collect the image of the second target region to better identify the people and action around the game table. The combination of the small pixel-size camera and the large pixel-size camera solves the problems of insufficient depth of field in the central hot zone and insufficient illumination in

the surrounding hot zone when a single camera is used to collect images including the game table region and people.

In some embodiments, a high-resolution camera may be used to collect the image of the first target region, and a low-resolution camera may be used to simultaneously collect the image of the second target region. The high-resolution camera is a center camera, and the low-resolution camera is the wide-angle camera. The image of the first target region obtained by photographing the game table region by means of the high-resolution center camera has high resolution. Therefore, the details of the game-related target on the game table may be detected from the image of the first target region, such as details of exchanged objects, exchanges, and cards. The low-resolution wide-angle camera is used to photograph people at the game table region and around the game table. The field of vision is wide, and the field coverage is strong. Therefore, the low-resolution wide-angle camera may collect the image of the second target region to better identify people and actions around the game table. The combination of a high-resolution center camera and a low-resolution wide-angle camera solves the problem that when a single camera is used to collect images including the game table region and people, the resolution of the center region and the coverage of the field of vision cannot be satisfied simultaneously.

In some embodiments, a classifier may be used to detect an image of the first target region, and locate each first target object in the image of the first target region, that is, a target object related to a game object, such as exchanged items, exchanges, and cards, and the region corresponding to each first target object may be annotated in the image of the first target region by means of a detection frame. Moreover, the classifier may classify the region corresponding to each first target object, and classify the target object related to the game object into a plurality of categories such as an exchanged item, an exchange, and a card. The classifier may be, for example, a deep convolutional neural network, and the present disclosure does not limit the type of the classifier.

In some embodiments, a classifier may be used to detect the image of the second target region, and locate the body of a person appearing in the image of the second target region,

including a face, a hand, and a body domain. The region of each second target object is annotated in the image of the second target region by means of a detection frame. Moreover, the classifier may classify the region corresponding to each second target object, and classify each second target object into a plurality of categories such as a face, a body, and a hand.

If the first target object includes a target object related to the game object and the second target object includes a target object related to the player, the association relationship between the first target object and the second target object may be determined in the following manner.

First, the first target object is mapped to the image of the second target region according to a positional relationship between the first image acquisition apparatus and the second image acquisition apparatus to determine each corresponding mapped target object.

If the positional relationship between the first image acquisition apparatus and the second image acquisition apparatus is known, the first target object is mapped into the image of the second target region according to internal parameters of the first image acquisition apparatus and internal parameters of the second image acquisition apparatus, to obtain corresponding mapped target objects. In the image of the second target region, the positional relationship between each target object related to the player and each mapped target object may reflect the positional relationship between the game object and the player corresponding to each first target object in the actual space. Therefore, an association relationship between each first target object and each target object related to the player is determined according to the position of each target object related to the player in the image of the second target region and the position of each mapped target object.

FIG. 2A is a schematic diagram of an image of a first target region collected by the first image acquisition apparatus. A target object 201 related to a game object is obtained by identifying the image of the first target region. In FIG. 2A, the target object 201 related to the game object is a game chip. FIG. 2B is a schematic diagram of an image of a second target region collected by a second image acquisition apparatus. The first target region includes a game table region of the first target region, and also includes a player and a dealer region around

the game table. Identification is performed based on the image of the second target region to obtain two target objects 211 and 212 related to the player.

According to the positional relationship between the first image acquisition apparatus and the second image acquisition apparatus, and the internal parameters of the first image acquisition apparatus and the second image acquisition apparatus, the target object 201 related to the game object may be mapped to the image of the second target region. A dashed box 202 in FIG. 2B represents a corresponding mapped target object 202. In the image of the second target region, based on the positions of the target objects 211 and 212 related to the player and the position of the mapped target object 202 corresponding to the target object 201 related to the game object, the association relationship between the target objects 211 and 212 related to the player and the target object 201 related to the game object is determined.

In some embodiments, the association relationship between each first target object and each target object related to the player may be determined according to the following method: if the distance between one target object related to the player and the target object mapped from one first target object is less than or equal to a first distance threshold, determining that the first target object is associated with the target object related to the player. The distance may be determined, for example, by the center position of the detection frame of the target object related to the player and the center position of the region of the mapped target object. For example, in FIG. 2B, the distance between the target object 211 related to the player and the mapped target object 202 corresponding to the target object 201 related to the game object is smaller than the first distance threshold. Therefore, it may be determined that the target object 211 related to the player may be associated with the target object 201 related to the game object. The specific value of the first distance threshold may be determined according to the type and number of target objects included in the second target region.

If the first target object includes a target object related to the game object and the second target object includes a target object related to the player and the target object related to the player, the association relationship between the first target object and the second target object may be determined in the following manner.

First, a correspondence between each first target object and each target object related to the game object in the image of the second target region is obtained according to the positional relationship between the first image acquisition apparatus and the second image acquisition apparatus. For example, each first target object may be mapped to the image of the second target region to obtain the corresponding position of each first target object. The correspondence between each first target object and each target object related to the game object in the image of the second target region is determined according to the distance between each target object related to the game object and the corresponding position in the image of the second target region.

Next, an association relationship between each first target object and each target object related to the player is determined according to the position of each target object related to the game object in the image of the second target region, the position of each target object related to the player in the image of the second target region, and the correspondence between each first target object and each target object related to the game object in the image of the second target region.

In some embodiments, the association relationship between each first target object and each player may be determined by means of the following method: if the distance between one target object related to the player and one target object related to the game object in the image of the second target region is less than or equal to a second distance threshold, determining that the target object related to the player is associated with the first target object corresponding to the target object related to the game object.

FIG. 2C is a schematic diagram of an image of a second target region collected by a second image acquisition apparatus. The image of the second target region includes the game table region in the first target region, and also includes the player and dealer regions around the game table. Two target objects 211 and 212 related to the player and a target object (game chip) 203 related to the game object are obtained by identifying the image of the second target region. The correspondence between each first target object in FIG. 2A and each target object related to the game object in FIG. 2C may be obtained according to the positional relationship between

the first image acquisition apparatus and the second image acquisition apparatus, and the internal parameters of the first image acquisition apparatus and the second image acquisition apparatus.

In one example, each first target object in FIG. 2A may be mapped to the image of the second target region to obtain the corresponding position of each first target object. The correspondence between the first target object and the target object related to the game object may be determined according to the distance between the corresponding positions of each target object related to the game object and each first target object. For example, after all the first target objects in FIG. 2A are mapped to the image of the second target region, if the corresponding positions between the target object 203 related to the game object in FIG. 2C and the first target object 201 in FIG. 2A are the shortest, it may be determined that the target object 203 related to the game object corresponds to the first target object 201.

If the distance between the position of the target object 211 related to the player and the target object 203 related to the game object is less than a second distance threshold, it may be determined that the target object 211 related to the player is associated with the first target object 201 corresponding to the target object 203 related to the game object. The specific value of the second distance threshold may be determined according to the type and number of target objects included in the second target region.

In some embodiments, the target object related to the player may include one or more of a face, a body, and a hand. The processor is further configured to obtain identity information of a corresponding player by means of one or more of the face, the body, and the hand, and each first target object is associated with the identity information of the player by means of an association relationship between the target object related to the player and the first target object.

In response to that the target object related to the player includes a face, the identity information of the corresponding player may be obtained by means of the face, and each first target object is associated with the identity information of the player by means of an association relationship between the target object related to the player and the first target object.

In some embodiments, the identity information of the player corresponding to the face may be obtained by means of the following method: obtaining face keypoint information of each face in the image of the second target region; and determining the identity information of the player corresponding to each face according to the face keypoint information. If the first target object associated with the face is known, it may be determined that the first target object is associated with the identity information of the player. For example, when it is determined that the face identified in the image of the second target region belongs to a certain player, and the name, gender, contact information, and other identity information of the player are known, the first target object associated with the face is associated with the identity information, that is, a target object corresponding to the first target object and related to the game object, such as an exchanged item, an exchange, and a card is associated with the identity information.

In one example, the identity information of the player corresponding to each face may be determined according to the face keypoint information by means of the following method: comparing the face keypoint information with the face image and/or face feature information of a reference person in a database, and determining the identity of the reference person matching the face keypoint information as the identity of the person corresponding to the face. Moreover, the face keypoint information and corresponding identity information may be determined as an identification result of the face. For example, if the reference person that matches the face keypoint information of face A (for example, the similarity is greater than or equal to a preset similarity threshold) is player M, the face is determined to be the face of the player M. In this way, the face features and identity of a person corresponding to the face may be determined.

In some embodiments, the identity information corresponding to each face may be determined at the beginning of the game. For example, when a player approaches a game table and sits on a seat, it may be considered that the player is about to participate in the game, and the identity of the player may be identified and entered, and the player may be tracked afterwards. The present disclosure does not limit the specific timing of determining the identity of a person.

In some embodiments, face identification may be performed on an image of the second target region by means of a face identification network. The face identification network may be, for example, a deep convolutional neural network, which includes at least a convolution layer and a pooling layer (or a softmax layer). The present disclosure does not limit the network type and network structure of the face identification network.

In embodiments of the present disclosure, by associating each first target object with the identity information of each player, the first target object may be monitored more effectively.

In response to that target objects related to the player include a face and a body, the identity information of the corresponding player may be obtained by means of the body, and each first target object is associated with the identity information of the player by means of an association relationship between the target object related to the player and the first target object.

In some embodiments, the identity information of the player corresponding to the body may be obtained by the following methods: obtaining face keypoint information of each face in the image of the second target region; determining, according to the face keypoint information, identity information of a player corresponding to each face; then obtaining body keypoint information of each body in the image of the second target region; determining a face associated with each body according to the face keypoint information of each face and the body keypoint information of each body; then respectively determining identity information of a player corresponding to each body according to the identity information of the player corresponding to each face and the face associated with each body; and finally associating each first target object with the identity information of each player according to the association relationship between each first target object and each body and the identity information of the player corresponding to each body.

Regarding the face, the identity information of the player corresponding to each face may be determined according to the foregoing method, and details are not described herein again.

Regarding the body, the body keypoint information corresponding to each body may be obtained by performing body identification on the image of the second target region, such as

body keypoints of 14 joint parts as shown in FIG. 3A, and the body keypoint information is used as the body identification result.

In some embodiments, the image of the second target region may be processed by means of a body identification network to obtain a body identification result. The body identification network may be, for example, a deep convolutional neural network. The present disclosure does not limit the network type and network structure of the body identification network.

After obtaining the face keypoint information of each face and the body keypoint information of each body, each face and each body may be associated. For example, if the area of an overlapping region between a region where face keypoints of the face A are located and a region where body keypoints of body B are located exceeds a preset area threshold, it may be considered that the face A is associated with the body B. That is, the face A and the body B correspond to the same player M. In this case, the identity information corresponding to the face A may be determined as the identity information corresponding to the body B, that is, the body B is the body of the player M. In this way, the association between the face and the body is realized, so that the identity information corresponding to the body may be determined according to the identity information corresponding to the face, thereby improving the efficiency and accuracy of identification.

In some embodiments, the face is associated with the body in the following manner: if the area of an overlapping region between a region where face keypoints of one face are located and a region where body keypoints of one body are located is greater than or equal to a first area threshold, determining that the face is associated with the body. Persons skilled in the art may set the first area threshold according to actual conditions, and the present disclosure does not limit the specific value of the first area threshold.

In the embodiments of the present disclosure, by determining the association relationship between each first target object and each body and the identity information of the player corresponding to each body, each first target object is associated with the identity information of each player. The body is closer to the first target object, i.e., closer to the target object related

to the game object, than the face, so the accuracy of the association between the first target object and the identity information of the player may be improved.

In response to that target objects related to the player include a face and a hand, the identity information of the corresponding player may be obtained by means of the hand, and each first target object is associated with the identity information of the player by means of an association relationship between the target object (hand) related to the player and the first target object.

In some embodiments, the identity information of the player corresponding to the hand may be obtained by the following methods: obtaining face keypoint information of each face in the image of the second target region; determining, according to the face keypoint information, identity information of a player corresponding to each face; then determining a hand associated with each face according to the position of each face and the position of each hand in the image of the second target region; then respectively determining identity information of a player corresponding to each hand according to the identity information of the player corresponding to each face and the hand associated with each face in the image of the second target region; and finally associating each first target object with the identity information of each player according to the association relationship between each first target object and each hand and the identity information of the player corresponding to each hand.

Regarding the face, the identity information of the player corresponding to each face may be determined according to the foregoing method, and details are not described herein again.

Regarding the hand, the face associated with each hand may be determined according to the position of each hand and the position of each face. Furthermore, according to the association between the face and the hand, the identity information of the player corresponding to each hand is determined.

In some embodiments, the face and the hand may be associated according to the following manner: if the distance between the position of one face and the position of one hand is less than or equal to a third distance threshold, determining that the face is associated with the hand. Persons skilled in the art may set the third distance threshold according to actual conditions, and the present disclosure does not limit the specific value of the third distance threshold.

In the embodiments of the present disclosure, by determining the association relationship between each first target object and each hand, and associating each first target object with the identity information of each player, since the hand is closer to the first target object, i.e., closer to the target object related to the game object than the face, so that the accuracy of the association between the first target object and the identity information of the player may be improved.

In response to that target objects related to the player include a face, a body, and a hand, the identity information of the corresponding player may be obtained by means of the hand, and each first target object is associated with the identity information of the player by means of the association relationship between the target object related to the player and the first target object and the identity information of the player corresponding to each hand.

In some embodiments, the identity information of the player corresponding to the hand may be obtained by means of the following method: obtaining face keypoint information of each face in the image of the second target region; determining, according to the face keypoint information, identity information of a player corresponding to each face; then obtaining body keypoint information of each body in the image of the second target region, and hand keypoint information of each hand in the image of the second target region; then determining a face associated with each body according to the face keypoint information of each face and the body keypoint information of each body; determining the identity information of the player corresponding to each body according to the identity information of the player corresponding to each face and the face associated with each body; determining a body associated with each hand according to the body keypoint information of each body and the hand keypoint information of each hand; finally determining the identity information of the player corresponding to each hand according to the identity information of the player corresponding to each body and the body associated with each hand; and associating each first target object with the identity information of each player according to the association relationship between each first target object and each hand and the identity information of the player corresponding to each hand.

Regarding the face and the body, the identity information of the corresponding player may be determined according to the foregoing method, and details are not described herein again.

Regarding the hand, the hand keypoint information corresponding to each hand may be obtained by performing hand identification on the image of the second target region, as shown in FIG. 3B, and the hand keypoint information is used as the hand identification result. FIG. 3B is a schematic diagram of hand keypoint information in a target object identification system provided by at least one embodiment of the present disclosure.

In some embodiments, the image of the second target region may be processed by means of a hand identification network to obtain a hand identification result. The hand identification network may be, for example, a deep convolutional neural network. The present disclosure does not limit the network type and network structure of the hand identification network.

After obtaining the face keypoint information of each face and the body keypoint information of each body, each face and each body may be associated by using the foregoing method, and details are not described herein again.

After obtaining the body keypoint information of the body and the keypoint information of the hand, each body and each hand may be associated. For example, if the body keypoint information of the body B and the hand keypoint information of the hand C satisfy a preset condition, it may be considered that the body B is associated with the hand C, that is, the body B and the hand C correspond to the same player M. In this case, the identity information corresponding to the body B may be determined as the identity information corresponding to the hand C, that is, the hand C is the hand of the player M.

The preset condition may be, for example, that an area of an overlapping region between a region where body keypoints of the body B are located and a region where hand keypoints of the hand C are located is greater than or equal to a preset area threshold; the distance between the region where the body keypoints of the body B are located and the region where the hand keypoints of the hand C are located is less than or equal to a preset distance threshold; or an angle between a first connecting line between an elbow keypoint and a hand keypoint in the body keypoints of the body B and a second connecting line between the hand keypoints of the

hand C is within a preset angle range. The present disclosure does not limit the preset conditions for determining the association between the body and the hand.

In some embodiments, the preset condition includes at least one of the following: the area of an overlapping region between a region where body keypoints of one body are located and a region where hand keypoints of one hand are located is greater than or equal to a second area threshold; the distance between the region where body keypoints of one body are located and the region where hand keypoints of one hand are located is less than or equal to a fourth distance threshold; and an angle between a first connecting line of the body keypoint information of one body and a second connecting line of the hand keypoint information of one hand is less than or equal to an angle threshold, where the first connecting line is a connecting line between an elbow keypoint and a hand keypoint in the body keypoints of the body, and the second connecting line is a connecting line between hand keypoints corresponding to the hand.

For example, for any one body and any one hand, the relationship between the body keypoint information corresponding to the body and the hand keypoint information corresponding to the hand may be analyzed.

In one case, the area of the overlapping region between the region where the body keypoints corresponding to the body are located and the region where the hand keypoints corresponding to the hand are located may be calculated. If the area is less than or equal to a preset second area threshold, it may be determined that the body is associated with the hand. Persons skilled in the art may set the second area threshold according to actual conditions, and the present disclosure does not limit the specific value of the second area threshold.

In one case, the distance between the region where the body keypoints corresponding to the body are located and the region where the hand keypoints corresponding to the hand are located, for example, the distance between the center point of the body and the center point of the hand may be calculated. If the distance is less than or equal to a preset fourth distance threshold, it may be determined that the body is associated with the hand. Persons skilled in the art may set the fourth distance threshold according to actual conditions, and the present disclosure does not limit the specific value of the fourth distance threshold.

In one case, an angle between a first connecting line of body keypoints corresponding to the body and a second connecting line of hand keypoints corresponding to the hand may be calculated. The first connecting line may be a connecting line between an elbow keypoint and a hand keypoint of the body keypoints corresponding to the body, and the second connecting line is a connecting line between hand keypoints corresponding to the hand. If the angle is less than or equal to a preset angle threshold, it may be determined that the body is associated with the hand. Persons skilled in the art may set the angle threshold according to actual conditions, and the present disclosure does not limit the specific value of the angle threshold.

As shown in FIG. 3A, the body may include 18 body keypoints (including 4 keypoints of the head), where 3 and 6 are elbow keypoints, 4 and 7 are hand keypoints, and the connecting line between 3 and 4 and the connecting line between 6 and 7 serve as the first connecting line. As shown in FIG. 3B, the hand may include 16 or 21 hand keypoints, and the connecting line between the keypoints 31 and 32 may be used as the second connecting line. It should be understood that FIGs. 3A and 3B are merely schematic examples of body keypoint information and hand keypoint information. The present disclosure does not limit the specific types of body keypoint information and hand keypoint information, and the selection of the first connecting line and the second connecting line.

In some embodiments, associating the hand with the first target object is further included. The hand associated with each first target object may be determined according to the position of each hand and the position of each first target object. Furthermore, according to the association between the hand and the first target object, the identity information of the player corresponding to each first target object is determined.

For example, if the distance between the position of the hand C and the position of the first target object D is less than or equal to a preset distance threshold, it may be considered that the hand C is associated with the first target object D, that is, the hand C and the first target object D correspond to the same player. In this case, the first target object D may be determined as a person M corresponding to the hand C, for example, the exchanged item corresponding to the first target object D is the exchanged item betted by the player M.

In the embodiments of the present disclosure, the identity information of the corresponding player is obtained by means of the association relationship between the hand and the body and the association relationship between the body and the face. The association between the hand and the body is closer than the association between the hand and the face, so the accuracy of the association between the first target object and the identity information of the player may be improved.

In some embodiments, the method further includes: associating each target object related to the player in the image of the second target region with a seat region corresponding to the game table, and associating each first target region with a seat region corresponding to each second target object.

In a scenario where the seat regions corresponding to the game table have one-to-one correspondence to the players, each second target object may be associated with each seat region. For example, eight seating regions corresponding to the game table may be sequentially numbered as: No. 1, No. 2, ... and No. 8. Regarding the second target object identified in the image of the second target region, the correspondence between the second target object and the seat region is determined according to the position of each second target object and the position of the eight seat regions. If one second target object corresponds to No. 2 seat region, the second target object may be associated with the No. 2 seat region, i.e., associated with No. 2 player of the game table.

At least one embodiment of the present disclosure provides a target object identification method. The target object identification method may be performed by an electronic device such as a terminal device or a server. The terminal device may be a User Equipment (UE), a mobile device, a user terminal, a terminal, a cellular phone, a cordless phone, a Personal Digital Assistant (PDA), a handheld device, a computing device, a vehicle-mounted device, a wearable device, or the like. The method may be implemented by a processor by invoking computer-readable instructions stored in a memory, and the specific implementation method may refer to the aforementioned target object identification system, and details are not described herein again.

FIG. 4 is a flowchart of a target object identification method provided by at least one embodiment of the present disclosure. As shown in FIG. 4, the method includes steps 401 and 402.

At step 401, each first target object is identified based on the image of the first target region, and each second target object is identified based on the image of the second target region.

The image of the first target region is collected by means of a first image acquisition apparatus, the image of the second target region is collected by means of the second image acquisition apparatus, and the second target region includes part or all of the first target region. The resolution of the first image acquisition apparatus is higher than that of the second image acquisition apparatus, and the field of view of the second image acquisition apparatus is greater than that of the first image acquisition apparatus.

At step 402, an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region is determined.

Each first target object is each target object in the first target region, and the second target object is each target object in the second target region.

In some embodiments, the first target object includes a target object related to a game object, and the second target object includes a target object related to a player. The determining an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region includes: mapping the first target object to the image of the second target region according to a positional relationship between the first image acquisition apparatus and the second image acquisition apparatus to determine each corresponding mapped target object; and determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the player in the image of the second target region and the position of each mapped target object.

In some embodiments, the determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the player in the image of the second target region and the position of each mapped target object includes: if the distance between one target object related to the player and the target object mapped from one first target object is less than or equal to a first distance threshold, determining that the first target object is associated with the target object related to the player.

In some embodiments, the first target object includes a target object related to a game object, and the second target objects include a target object related to a game object and a target object related to a player. The determining an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region includes: obtaining a correspondence between each first target object and each target object related to the game object in the image of the second target region according to the positional relationship between the first image acquisition apparatus and the second image acquisition apparatus; and determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the game object in the image of the second target region, the position of each target object related to the player in the image of the second target region, and the correspondence between each first target object and each target object related to the game object in the image of the second target region.

In some embodiments, the determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the game object in the image of the second target region, the position of each target object related to the player in the image of the second target region, and the correspondence between each first target object and each target object related to the game object in the image of the second target region includes: if the distance between one target object related to the player and one target object related to the game object in the image of the second target region is less than or equal to a second distance threshold, determining that the

target object related to the player is associated with the first target object corresponding to the target object related to the game object.

In some embodiments, the target object related to the player includes a face. The determining an association relationship between each first target object and each target object related to the player includes: determining an association relationship between each first target object and each face; obtaining face keypoint information of each face in the image of the second target region; determining identity information of a player corresponding to each face according to the face keypoint information; and associating each first target object with the identity information of each player according to the association relationship between each first target object and each face and the identity information of the player corresponding to each face.

In some embodiments, target objects related to the player include a face and a body. The determining an association relationship between each first target object and each target object related to the player includes: determining an association relationship between each first target object and each body; obtaining face keypoint information of each face in the image of the second target region; determining, according to the face keypoint information, identity information of a player corresponding to each face; obtaining body keypoint information of each body in the image of the second target region; determining a face associated with each body according to the face keypoint information of each face and the body keypoint information of each body; respectively determining identity information of a player corresponding to each body according to the identity information of the player corresponding to each face and the face associated with each body; and associating each first target object with the identity information of each player according to the association relationship between each first target object and each body and the identity information of the player corresponding to each body.

In some embodiments, target objects related to the player include a face and a hand. The determining an association relationship between each first target object and each target object related to the player includes: determining an association relationship between each first target

object and each hand; obtaining face keypoint information of each face in the image of the second target region; determining, according to the face keypoint information, identity information of a player corresponding to each face; determining a hand associated with each face according to the position of each face and the position of each hand in the image of the second target region; respectively determining identity information of a player corresponding to each hand according to the identity information of the player corresponding to each face and the hand associated with each face in the image of the second target region; and associating each first target object with the identity information of each player according to the association relationship between each first target object and each hand and the identity information of the player corresponding to each hand.

In some embodiments, the determining a hand associated with each face according to the position of each face and the position of each hand in the image of the second target region includes: if the distance between the position of one face and the position of one hand in the image of the second target region is less than or equal to a third distance threshold, determining that the face is associated with the hand.

In some embodiments, target objects related to the player include a face, a body, and a hand. The determining an association relationship between each first target object and each target object related to the player includes: determining an association relationship between each first target object and each hand; obtaining face keypoint information of each face in the image of the second target region; determining, according to the face keypoint information, identity information of a player corresponding to each face; obtaining body keypoint information of each body in the image of the second target region; obtaining hand keypoint information of each hand in the image of the second target region; determining a face associated with each body according to the face keypoint information of each face and the body keypoint information of each body; determining the identity information of the player corresponding to each body according to the identity information of the player corresponding to each face and the face associated with each body; determining a body associated with each hand according to the body keypoint information of each body and the hand keypoint information of each hand;

determining the identity information of the player corresponding to each hand according to the identity information of the player corresponding to each body and the body associated with each hand; and associating each first target object with the identity information of each player according to the association relationship between each first target object and each hand and the identity information of the player corresponding to each hand.

In some embodiments, the determining a face associated with each body according to the face keypoint information of each face and the body keypoint information of each body includes: if the area of an overlapping region between a region where face keypoints of one face are located and a region where body keypoints of one body are located is greater than or equal to a first area threshold, determining that the face is associated with the body.

In some embodiments, the determining a body associated with each hand according to the body keypoint information of each body and the hand keypoint information of each hand includes: if body keypoint information of one body and hand keypoint information of one hand satisfy a preset condition, determining that the body is associated with the hand.

In some embodiments, the preset condition includes at least one of the following: the area of an overlapping region between a region where body keypoints of one body are located and a region where hand keypoints of one hand are located is greater than or equal to a second area threshold; the distance between the region where body keypoints of one body are located and the region where hand keypoints of one hand are located is less than or equal to a fourth distance threshold; and an angle between a first connecting line of the body keypoint information of one body and a second connecting line of the hand keypoint information of one hand is less than or equal to an angle threshold, where the first connecting line is a connecting line between an elbow keypoint and a hand keypoint in the body keypoints of the body, and the second connecting line is a connecting line between hand keypoints corresponding to the hand.

FIG. 5 is a schematic structural diagram of a target object identification apparatus provided by at least one embodiment of the present disclosure. For specific implementation of the target object identification apparatus provided by the embodiments of the present

disclosure, reference may be made to the foregoing target object identification system, and details are not described herein again.

As shown in FIG. 5, the apparatus includes an identifying unit 501 and a determining unit 502.

The identifying unit 501 is configured to identify each first target object according to an image of a first target region, and identify each second target object according to an image of a second target region. The image of the first target region is collected by means of a first image acquisition apparatus, the image of the second target region is collected by means of a second image acquisition apparatus, and the second target region includes part or all of the first target region. The resolution of the first image acquisition apparatus is higher than that of the second image acquisition apparatus, and the field of view of the second image acquisition apparatus is greater than that of the first image acquisition apparatus. The determining unit 502 is configured to determine an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region, where the first target object is each target object in the first target region, and the second target object is each target object in the second target region.

FIG. 6 is a schematic structural diagram of a target object identification device provided by at least one embodiment of the present disclosure. The device includes: a processor; and a memory configured to store processor-executable instructions, where the processor is configured to invoke the instructions stored by the memory to execute the target object identification method according to at least one embodiment.

The present disclosure further provides a computer-readable storage medium, having computer program instructions stored thereon, where when the computer program instructions are executed by a processor, the target object identification method according to at least one embodiment is implemented.

Persons skilled in the art should understand that one or more embodiments of the specification may be provided as methods, systems, or computer program products. Therefore, one or more embodiments of the specification may be in the form of a full hardware

embodiment, a full software embodiment, or a combination of software and hardware embodiments. Moreover, one or more embodiments of the specification may be in the form of a computer program product implemented on one or more computer usable storage media (including but not limited to a disk memory, a CD-ROM, an optical memory, etc.) having computer usable program codes stored therein.

The embodiments of the specification also provide a computer-readable storage medium, having computer programs stored hereon. When the programs are executed by a processor, steps of a method for detecting a driver's gaze region described in any embodiment of the specification are implemented, and/or steps of a method for training a neural network of a driver's gaze region described in any embodiment of the specification are implemented. The "and/or" means having at least one of two features, for example, "A and/or B" includes three solutions: A, B, and "A and B".

One or more embodiments in the specification are described in a progressive manner, and the same or similar portions between the various embodiments may be referred to each other, and each embodiment focuses on the differences from other embodiments. In particular, the data processing device embodiment is basically similar to the method embodiment, the description is relatively simple, and the relevant parts may be referred to the description of the method embodiment.

The above describes the specific embodiments of the specification. Other embodiments are within the scope of the appended claims. In some cases, the actions or steps recited in the claims may be performed in a different order than the embodiments and may still achieve the desired results. In addition, the processes depicted in the drawings are not necessarily in a particular order or in a sequential order to achieve the desired results. In some embodiments, multi-task processing and parallel processing are also possible or may be advantageous.

Embodiments of the subject matter and functional operations described in the specification may be implemented in the following: digital electronic circuits, tangibly embodied computer software or firmware, computer hardware including the structures disclosed in the specification and the structural equivalents thereof, or a combination of one or

more of the foregoing elements. Embodiments of the subject matter described in the specification may be implemented as one or more computer programs, that is, one or more modules in computer program instructions encoded on a tangible non-transitory program carrier to be executed by a data processing device or in the computer program instructions controlling operations of the data processing apparatus. Alternatively or additionally, the program instructions may be encoded on a manually generated propagation signal, such as a machine-generated electrical, optical, or electromagnetic signal, which is generated to encode and transmit the information to a suitable receiver apparatus to be executed by the data processing apparatus. The computer storage medium may be a machine-readable storage device, a machine-readable storage substrate, a random or serial access memory device, or a combination of one or more of the foregoing devices.

The processing and logic flow described in the specification may be performed by one or more programmable computers executing one or more computer programs to perform corresponding functions by operating on input data and generating an output. The processing and logic flow may also be performed by a dedicated logic circuit, such as a Field Programmable Gate Array (FPGA) or an Application Specific Integrated Circuit (ASIC), and the apparatus may also be implemented as a dedicated logic circuit.

Computers suitable for executing a computer program include, for example, a general-purpose and/or special-purpose microprocessor, or any other type of central processing unit. Generally, the central processing unit receives instructions and data from a read-only memory and/or a random access memory. The basic components of a computer include a central processing unit for implementing or executing instructions and one or more memory devices for storing instructions and data. Generally, the computer also includes one or more mass storage devices, such as magnetic disks, magneto-optical disks, or optical disks, for storing data, or the computer is operatively coupled to the mass storage device to receive data from the mass storage device or transmit data to the mass storage device, or both. However, the computer does not necessarily have such a device. In addition, the computer may be embedded in another device, such as a mobile phone, a Personal Digital Assistant (PDA), a mobile audio or video

player, a game console, a Global Positioning System (GPS) receiver, or, a portable storage device, for example, a Universal Serial Bus (USB) flash drive, to name a few.

Computer-readable media suitable for storing computer program instructions and data include all forms of non-volatile memory, media, and memory devices, including, for example, semiconductor memory devices (such as EPROM, EEPROM, and flash memory devices), magnetic disks (such as internal hard disks or removable disks), magneto-optical disks, and CD ROM and DVD-ROM disks. The processor and the memory may be supplemented by, or incorporated in, a special-purpose logic circuit.

Although the specification contains many specific implementation details, these should not be construed as limiting the scope of any invention or the scope of protection, but rather are mainly used to describe the features of specific embodiments of a particular invention. Certain features that are described in the specification in multiple embodiments may also be implemented in combination in a single embodiment. On the other hand, various features described in a single embodiment may also be implemented separately in multiple embodiments or in any suitable sub-combination. In addition, although features may function in certain combinations as described above and are even so initially claimed, one or more features from the claimed combination may, in some cases, be removed from the combination, and the claimed combination may point to a sub-combination or a variant of the sub-combination.

Similarly, although the operations are depicted in a particular order in the drawings, this should not be construed as requiring these operations to be performed in the specific order shown or sequentially, or that all illustrated operations be performed to achieve the desired result. In some cases, multitasking and parallel processing may be advantageous. In addition, the separation of various system modules and components in the foregoing embodiments should not be understood as requiring such separation in all embodiments, and it should be understood that the described program components and systems may generally be integrated together in a single software product, or packaged into multiple software products.

Therefore, specific embodiments of the subject matter have been described. Other embodiments are within the scope of the appended claims. In some cases, the actions recited in the claims may be performed in a different order and still achieve the desired result. In addition, the processes depicted in the drawings are not necessarily required to be in the specific order or sequence shown to achieve a desired result. In some implementations, multitasking and parallel processing may be advantageous.

The above are only preferred embodiments of one or more embodiments of the specification, and are not intended to limit one or more embodiments of the specification. Any modification, equivalent substitution and improvement, etc. made within the spirit and principle of one or more embodiments of the specification should be included in the scope of protection of one or more embodiments of the specification.

CLAIMS

1. A target object identification system, comprising a first image acquisition apparatus, a second image acquisition apparatus, and a processor, wherein:

the first image acquisition apparatus is configured to collect an image of a first target region, the second image acquisition apparatus is configured to synchronously collect an image of a second target region, and the second target region comprises part or all of the first target region; the resolution of the first image acquisition apparatus is higher than that of the second image acquisition apparatus, and the field of view of the second image acquisition apparatus is greater than that of the first image acquisition apparatus;

the processor is configured to identify each first target object according to the image of the first target region, and identify each second target object according to the image of the second target region; and determine an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region, wherein the first target object is each target object in the first target region, and the second target object is each target object in the second target region.

2. The system according to claim 1, wherein the first target object comprises a target object related to a game object, and the second target object comprises a target object related to a player; the determining an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region comprises:

mapping the first target object to the image of the second target region according to a positional relationship between the first image acquisition apparatus and the second image acquisition apparatus to determine each corresponding mapped target object; and

determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the player in the image of the second target region and the position of each mapped target object.

3. The system according to claim 2, wherein the determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the player in the image of the second target region and the position of each mapped target object comprises:

if the distance between one target object related to the player and the target object mapped from one first target object is less than or equal to a first distance threshold, determining that the first target object is associated with the target object related to the player.

4. The system according to claim 1, wherein the first target object comprises a target object related to a game object, and the second target objects comprise a target object related to a game object and a target object related to a player; the determining an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region comprises:

obtaining a correspondence between each first target object and each target object related to the game object in the image of the second target region according to the positional relationship between the first image acquisition apparatus and the second image acquisition apparatus; and

determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the game object in the image of the second target region, the position of each target object related to the player in the image of the second target region, and the correspondence between each first target object and each target object related to the game object in the image of the second target region.

5. The system according to claim 4, wherein the determining an association relationship between each first target object and each target object related to the player according to the

position of each target object related to the game object in the image of the second target region, the position of each target object related to the player in the image of the second target region, and the correspondence between each first target object and each target object related to the game object in the image of the second target region comprises:

if the distance between one target object related to the player and one target object related to the game object in the image of the second target region is less than or equal to a second distance threshold, determining that the target object related to the player is associated with the first target object corresponding to the target object related to the game object.

6. The system according to any one of claims 2 to 5, wherein

the target object related to the player comprises a face;

the processor configured to determine the association relationship between each first target object and each target object related to the player, is configured to determine an association relationship between each first target object and each face;

the processor is further configured to:

obtain face keypoint information of each face in the image of the second target region;
and

determine identity information of a player corresponding to each face according to the face keypoint information; and associate each first target object with the identity information of each player according to the association relationship between each first target object and each face and the identity information of the player corresponding to each face.

7. The system according to any one of claims 2 to 5, wherein

target objects related to the player comprise a face and a body;

the processor configured to determine the association relationship between each first target object and each target object related to the player, is configured to determine an association relationship between each first target object and each body;

the processor is further configured to:

obtain face keypoint information of each face in the image of the second target region;

determine, according to the face keypoint information, identity information of a player corresponding to each face;

obtain body keypoint information of each body in the image of the second target region;

determine a face associated with each body according to the face keypoint information of each face and the body keypoint information of each body;

respectively determine identity information of a player corresponding to each body according to the identity information of the player corresponding to each face and the face associated with each body; and

associate each first target object with the identity information of each player according to the association relationship between each first target object and each body and the identity information of the player corresponding to each body.

8. The system according to any one of claims 2 to 5, wherein

target objects related to the player comprise a face and a hand;

the processor configured to determine the association relationship between each first target object and each target object related to the player, is configured to determine an association relationship between each first target object and each hand;

the processor is further configured to:

obtain face keypoint information of each face in the image of the second target region;

determine, according to the face keypoint information, identity information of a player corresponding to each face;

determine a hand associated with each face according to the position of each face and the position of each hand in the image of the second target region;

respectively determine identity information of a player corresponding to each hand according to the identity information of the player corresponding to each face in the image of the second target region and the hand associated with each face; and

associate each first target object with the identity information of each player according to the association relationship between each first target object and each hand and the identity information of the player corresponding to each hand.

9. The system according to claim 8, wherein the determining a hand associated with each face according to the position of each face and the position of each hand in the image of the second target region comprises:

if the distance between the position of one face and the position of one hand in the image of the second target region is less than or equal to a third distance threshold, determining that the face is associated with the hand.

10. The system according to any one of claims 2 to 5, wherein

target objects related to the player comprise a face, a body, and a hand;

the processor configured to determine the association relationship between each first target object and each target object related to the player, is configured to determine an association relationship between each first target object and each hand;

the processor is further configured to:

obtain face keypoint information of each face in the image of the second target region;

determine, according to the face keypoint information, identity information of a player corresponding to each face;

obtain body keypoint information of each body in the image of the second target region;

obtain hand keypoint information of each hand in the image of the second target region;

determine a face associated with each body according to the face keypoint information of each face and the body keypoint information of each body;

determine the identity information of the player corresponding to each body according to the identity information of the player corresponding to each face and the face associated with each body;

determine a body associated with each hand according to the body keypoint information of each body and the hand keypoint information of each hand;

determine the identity information of the player corresponding to each hand according to the identity information of the player corresponding to each body and the body associated with each hand; and

associate each first target object with the identity information of each player according to the association relationship between each first target object and each hand and the identity information of the player corresponding to each hand.

11. The system according to claim 7 or 10, wherein the determining a face associated with each body according to the face keypoint information of each face and the body keypoint information of each body comprises:

if the area of an overlapping region between a region where face keypoints of one face are located and a region where body keypoints of one body are located is greater than or equal to a first area threshold, determining that the face is associated with the body.

12. The system according to claim 10 or 11, wherein the determining a body associated with each hand according to the body keypoint information of each body and the hand keypoint information of each hand comprises:

if body keypoint information of one body and hand keypoint information of one hand satisfy a preset condition, determining that the body is associated with the hand;

wherein the preset condition comprises at least one of the following:

the area of an overlapping region between a region where body keypoints of one body are located and a region where hand keypoints of one hand are located is greater than or equal to a second area threshold;

the distance between the region where body keypoints of one body are located and the region where hand keypoints of one hand are located is less than or equal to a fourth distance threshold; and

an angle between a first connecting line of the body keypoint information of one body and a second connecting line of the hand keypoint information of one hand is less than or equal to an angle threshold, wherein the first connecting line is a connecting line between an elbow keypoint and a hand keypoint in the body keypoints of the body, and the second connecting line is a connecting line between hand keypoints corresponding to the hand.

13. A target object identification method, comprising:

identifying each first target object according to an image of a first target region, and identifying each second target object according to an image of a second target region, wherein the image of the first target region is collected by means of a first image acquisition apparatus, the image of the second target region is collected by means of a second image acquisition apparatus, and the second target region comprises part or all of the first target region; the resolution of the first image acquisition apparatus is higher than that of the second image

acquisition apparatus, and the field of view of the second image acquisition apparatus is greater than that of the first image acquisition apparatus; and

determining an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region, wherein the first target object is each target object in the first target region, and the second target object is each target object in the second target region.

14. The method according to claim 13, wherein the first target object comprises a target object related to a game object, and the second target object comprises a target object related to a player; the determining an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region comprises:

mapping the first target object to the image of the second target region according to a positional relationship between the first image acquisition apparatus and the second image acquisition apparatus to determine each corresponding mapped target object; and

determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the player in the image of the second target region and the position of each mapped target object.

15. The method according to claim 14, wherein the determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the player in the image of the second target region and the position of each mapped target object comprises:

if the distance between one target object related to the player and the target object mapped from one first target object is less than or equal to a first distance threshold, determining that the first target object is associated with the target object related to the player.

16. The method according to claim 13, wherein the first target object comprises a target object related to a game object, and the second target objects comprise a target object related to a game object and a target object related to a player; the determining an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region comprises:

obtaining a correspondence between each first target object and each target object related to the game object in the image of the second target region according to the positional relationship between the first image acquisition apparatus and the second image acquisition apparatus; and

determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the game object in the image of the second target region, the position of each target object related to the player in the image of the second target region, and the correspondence between each first target object and each target object related to the game object in the image of the second target region.

17. The method according to claim 16, wherein the determining an association relationship between each first target object and each target object related to the player according to the position of each target object related to the game object in the image of the second target region, the position of each target object related to the player in the image of the second target region, and the correspondence between each first target object and each target object related to the game object in the image of the second target region comprises:

if the distance between one target object related to the player and one target object related to the game object in the image of the second target region is less than or equal to a second distance threshold, determining that the target object related to the player is associated with the first target object corresponding to the target object related to the game object.

18. A target object identification apparatus, comprising:

an identifying unit, configured to identify each first target object according to an image of a first target region, and identify each second target object according to an image of a second target region, wherein the image of the first target region is collected by means of a first image acquisition apparatus, the image of the second target region is collected by means of a second image acquisition apparatus, and the second target region comprises part or all of the first target region; the resolution of the first image acquisition apparatus is higher than that of the second image acquisition apparatus, and the field of view of the second image acquisition apparatus is greater than that of the first image acquisition apparatus; and

a determining unit, configured to determine an association relationship between each first target object in the image of the first target region and each second target object in the synchronously collected image of the second target region, wherein the first target object is each target object in the first target region, and the second target object is each target object in the second target region.

19. An electronic device, comprising:

a processor; and

a memory configured to store processor-executable instructions,

wherein the processor is configured to invoke the instructions stored in the memory, so as to execute the method according to any one of claims 13 to 17.

20. A computer-readable storage medium, having computer program instructions stored thereon, wherein when the computer program instructions are executed by a processor, the method according to any one of claims 13 to 17 is implemented.