

of results of the detection by the object detecting unit and results of the tracking by the object tracking unit; a data recording control unit for forming a database from the feature descriptors generated by the descriptor generating unit and the pieces of image data of the objects corresponding to the feature descriptors; an image retrieving unit for retrieving, from the database formed by the data recording control unit, object groups that match a set retrieval condition and form a pair of object groups appearing in pieces of image data obtained by capturing different regions, each of the object groups corresponding to a corresponding one of the regions; a feature extracting unit for extracting a feature to be used for checking, from pieces of image data and feature descriptors of each of the object groups retrieved by the image retrieving unit; and a determining unit for determining whether the object groups forming the pair of object groups are identical to each other, by checking features against each other, each of the features being extracted by the feature extracting unit, in which the feature extracting unit performs feature-based clustering between the pieces of image data of each of the retrieved object groups, using the pieces of image data and the feature descriptors of a corresponding one of the object groups retrieved by the image retrieving unit, and extracts, from pieces of image data in a cluster defined by a result of the clustering, one feature for the cluster, the one feature being the feature to be used for checking.

ADVANTAGEOUS EFFECTS OF INVENTION

[0008] According to the invention, a determination as to whether objects are identical objects can be made between images shot by a plurality of cameras robustly for changes in features caused by a background or occlusion.

BRIEF DESCRIPTION OF DRAWINGS

[0009] FIG. 1 is a block diagram showing a configuration of an image processing device according to a first embodiment.

FIG. 2 is a diagram showing an example of a result of image recognition obtained by the image processing device according to the first embodiment.

FIGS. 3A and 3B are diagrams showing exemplary hardware configurations of

objects in a checking process of the image processing device 100 according to the first embodiment.

FIG. 6A is a diagram showing image data of the object A shown in FIG. 2, and FIG. 6B is a diagram showing image data of the object C shown in FIG. 2.

As shown in FIG. 6A, even if pieces of image data are obtained by tracking the same object A, a part of the object A may be hidden by, for example, an obstacle Y. In addition, even if pieces of image data are obtained by tracking the same object A, when, for example, the posture of the object has been changed, captured images differ in content from each other. Hence, when one of four pieces of image data of the object A shown in FIG. 6A (e.g., a piece of image data obtained by capturing an object Ac) is selected and compared with a piece of image data selected from three pieces of image data of the object C of FIG. 6B (e.g., a piece of image data obtained by capturing an object Cb), the checking accuracy of the image checking unit 108 decreases due to the dependence on the selected pieces of image data.

[0047] Hence, the image checking unit 108 defines a cluster using, for example, four pieces of image data shown in FIG. 6A, and extracts a feature from the pieces of image data in the defined cluster. Likewise, the image checking unit 108 defines a cluster using, for example, three pieces of image data shown in FIG. 6B, and extracts a feature from the pieces of image data in the defined cluster. The determining unit 108c compares the extracted feature of the object A with the extracted feature of the object C, by which a result of determination can be restrained from depending on image data.

[0048] As described above, the first embodiment includes the object detecting unit 103a that detects objects each appearing in a corresponding one of pieces of image data, by analyzing the pieces of image data; the object tracking unit 103b that tracks the detected objects in a time direction; the descriptor generating unit 104 that generates

CLAIMS

1. An image processing device comprising:
 - an object detecting unit for detecting objects each appearing in a corresponding one of pieces of image data, by analyzing the pieces of image data;
 - an object tracking unit for tracking the objects detected by the object detecting unit, in a time direction;
 - a descriptor generating unit for generating feature descriptors of the respective objects on a basis of results of the detection by the object detecting unit and results of the tracking by the object tracking unit;
 - a data recording control unit for forming a database from the feature descriptors generated by the descriptor generating unit and the pieces of image data of the objects corresponding to the feature descriptors;
 - an image retrieving unit for retrieving, from the database formed by the data recording control unit, object groups that match a set retrieval condition and form a pair of object groups appearing in pieces of image data obtained by capturing different regions, each of the object groups corresponding to a corresponding one of the regions;
 - a feature extracting unit for extracting a feature to be used for checking, from pieces of image data and feature descriptors of each of the object groups retrieved by the image retrieving unit; and
 - a determining unit for determining whether the object groups forming the pair of object groups are identical to each other, by checking features against each other, each of the features being extracted by the feature extracting unit, wherein the feature extracting unit performs feature-based clustering between the pieces of image data of each of the retrieved object groups, using the pieces of image data and the feature descriptors of a corresponding one of the object groups retrieved by the image retrieving

unit, and extracts, from pieces of image data in a cluster defined by a result of the clustering, one feature for the cluster, the one feature being the feature to be used for checking.

2. The image processing device according to claim 1, wherein each of the feature descriptors includes a visual feature of a corresponding one of the objects and location information of the corresponding one of the objects.

3. An image processing method comprising the steps of:

- detecting, by an object detecting unit, objects each appearing in a corresponding one of pieces of image data by analyzing the pieces of image data;
- tracking, by an object tracking unit, the detected objects in a time direction;
- generating, by a descriptor generating unit, feature descriptors of the respective detected objects on a basis of results of the detection of the objects and results of the tracking of the detected objects;
- forming, by a data recording control unit, a database from the generated feature descriptors and the pieces of image data of the objects corresponding to the feature descriptors;
- retrieving, by an image retrieving unit, from the formed database, object groups that match a set retrieval condition and form a pair of object groups appearing in pieces of image data obtained by capturing different regions, each of the object groups corresponding to a corresponding one of the regions;
- extracting, by a feature extracting unit, a feature to be used for checking, from pieces of image data and feature descriptors of each of the retrieved object groups;

determining, by a determining unit, whether the object groups forming the pair of object groups are identical to each other, by checking features against each other, each of the features being extracted; and

performing, by the feature extracting unit, feature-based clustering between the pieces of image data of each of the retrieved object groups, using the pieces of image data and the feature descriptors of a corresponding one of the retrieved object groups, and extracting, from pieces of image data in a cluster defined by a result of the clustering, one feature for the cluster, the one feature being the feature to be used for checking.