(19) **United States**

(12) **Patent Application Publication** (10) Pub. No.: **US 2017/0201733 A1**

MUJIBIYA et al. (43) **Pub. Date:** **Jul. 13, 2017**

(54) **DISPLAY CONTROL SYSTEM, DISPLAY CONTROL DEVICE, DISPLAY CONTROL METHOD, AND PROGRAM**

(71) Applicant: **RAKUTEN, INC.**, Tokyo (JP)

(72) Inventors: **Adiyan MUJIBIYA**, Setagaya-ku, Tokyo (JP); **Shogo YAMASHITA**, Setagaya-ku, Tokyo (JP)

(57) **ABSTRACT**

Labor of photographing images of an object can be reduced in a case where the images of the object viewed from a viewpoint moving along with an orbit are displayed. Image obtaining means of a display control system obtains a plurality of image data pieces generated by photographing an object from a plurality of photographing positions that are different from one another in photographing directions. Information obtaining means obtains photograph information relating to the photographing positions of the respective image data pieces in a three-dimensional space based on the image data pieces. Image selecting means selects some of the image data pieces based on the photograph information of the respective image data pieces and orbit information relating to an orbit of a viewpoint that moves while changing a viewing direction in the three-dimensional space. Display control means displays, on display means, the image data pieces selected by the image selecting means in an order according to the orbit.

26

FIG.1

FIG.2

FIG.3

40

ABC AUCTION
USED WATCH

41

42A   42B   42C

CURRENT
PRICE   1500   YEN BIDDING PRICE [   ] [BID]

TIME LEFT   10 HOURS 36 MINUTES 16 SECONDS

NUMBER
OF BIDS   15

CONDITION   USED
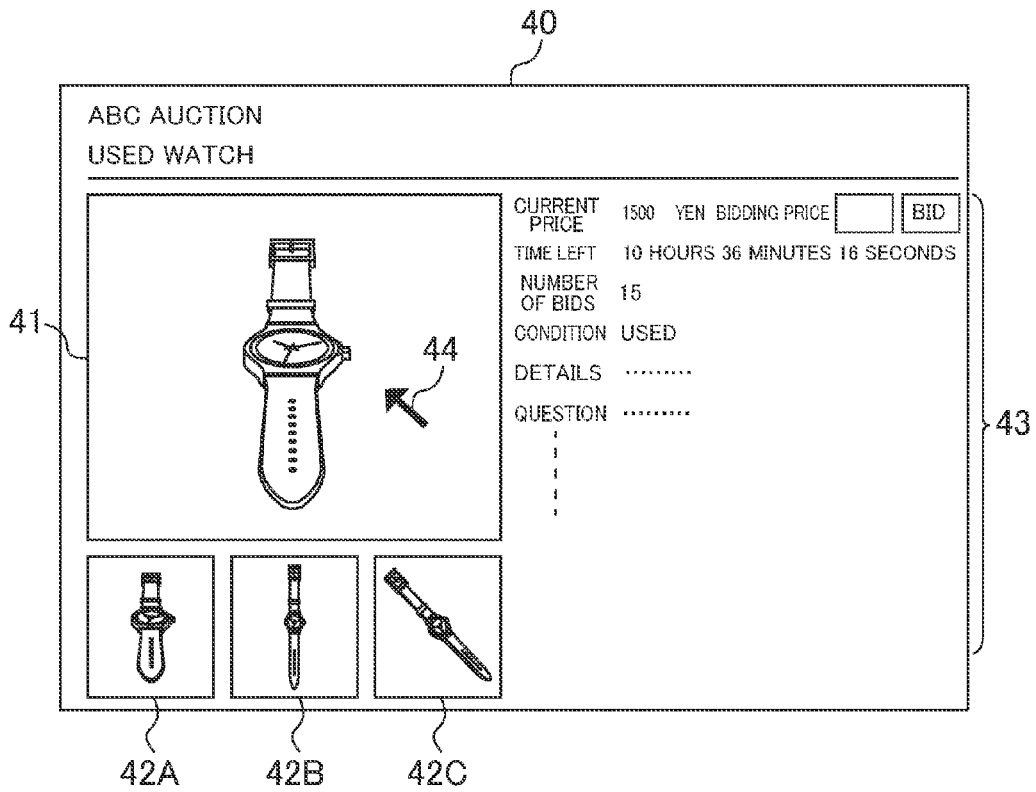
DETAILS   ....

QUESTION   ....

44

43

FIG.4

41A

41B

41C

41D

41E
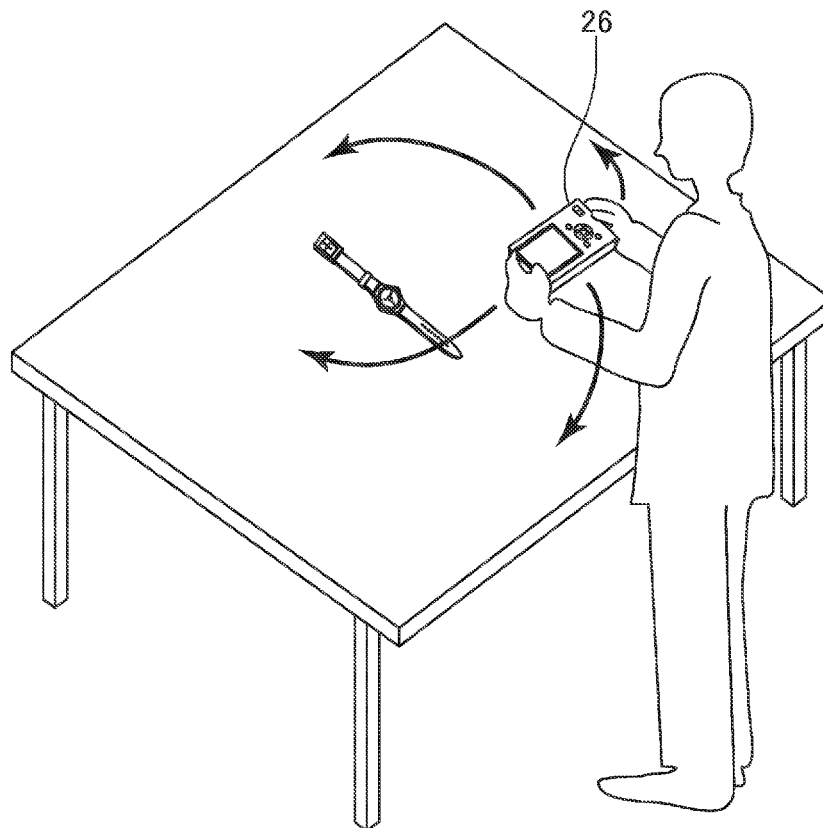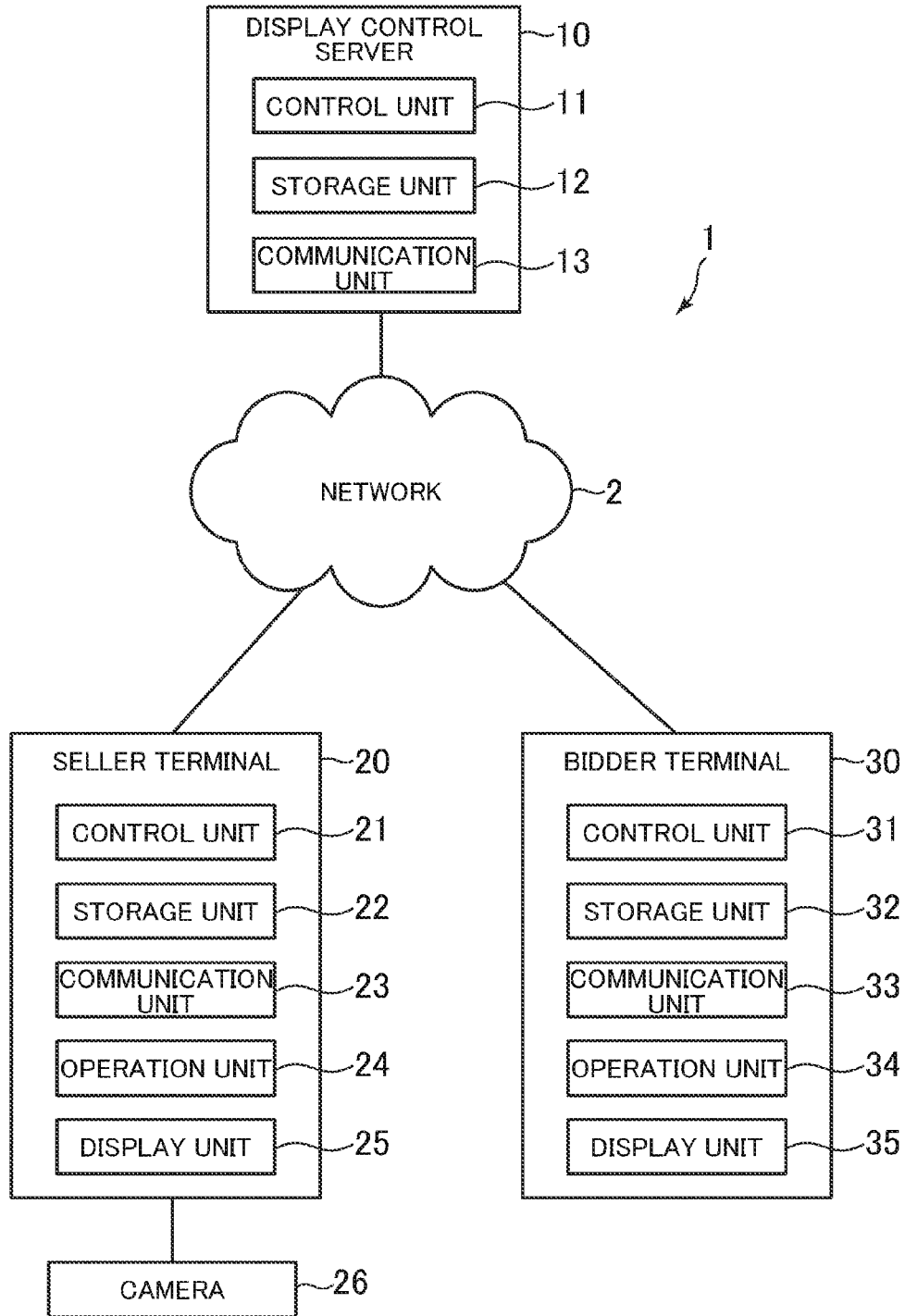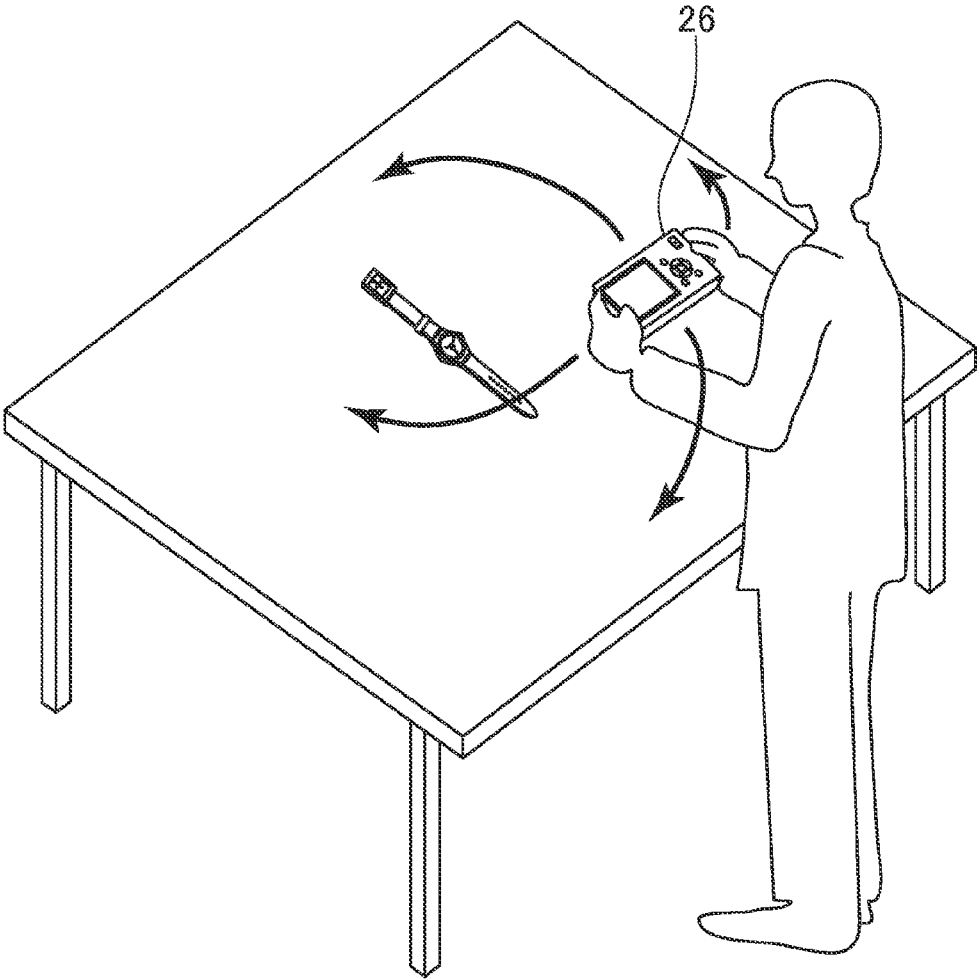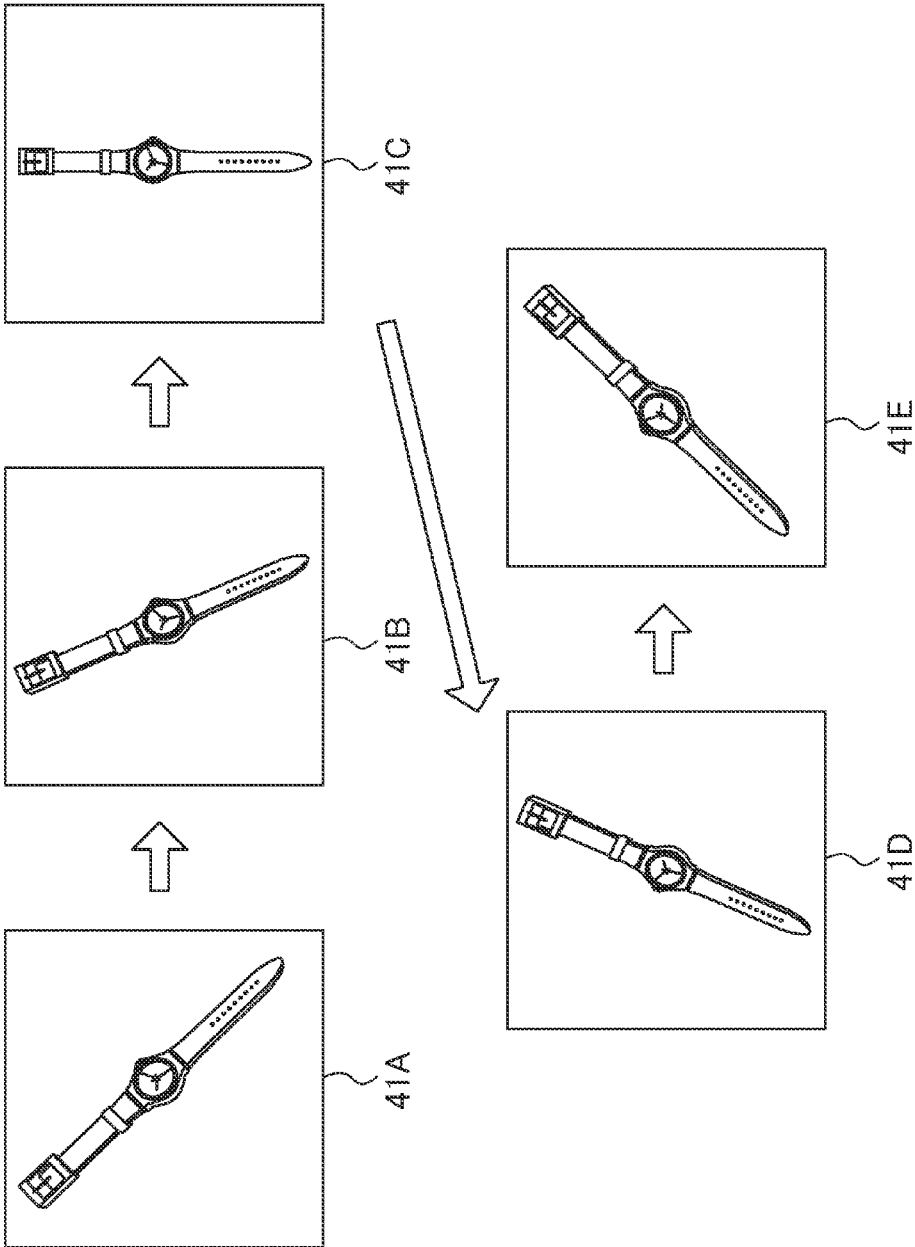
FIG.5
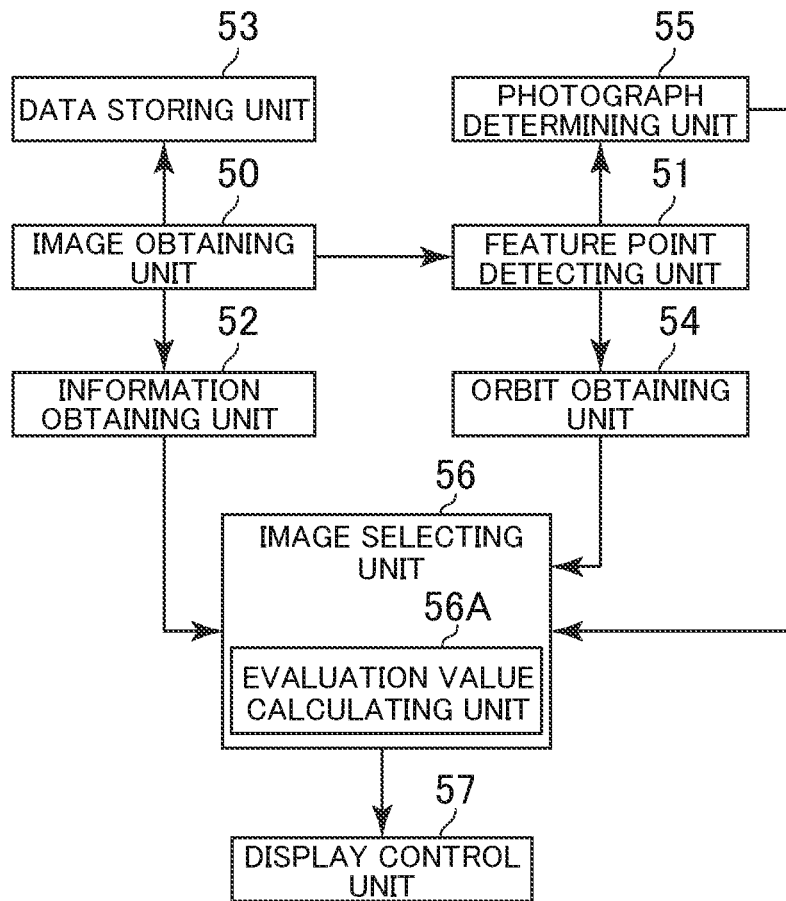
FIG.6
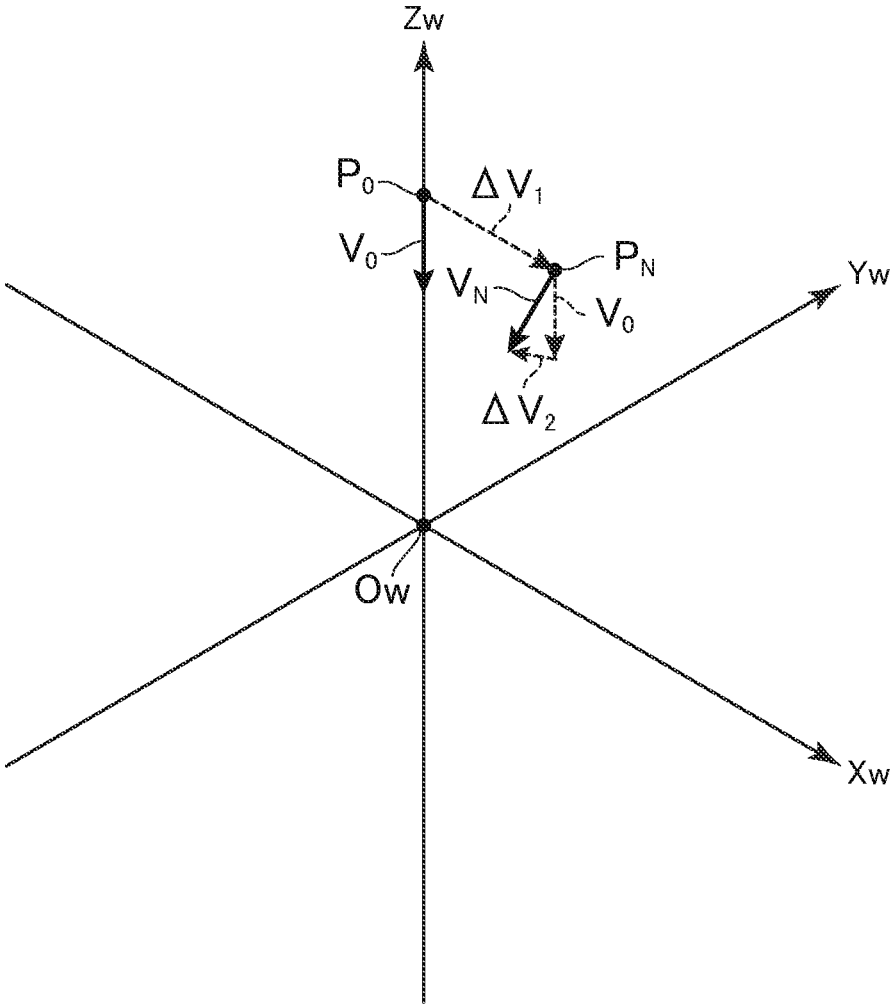
FIG.7
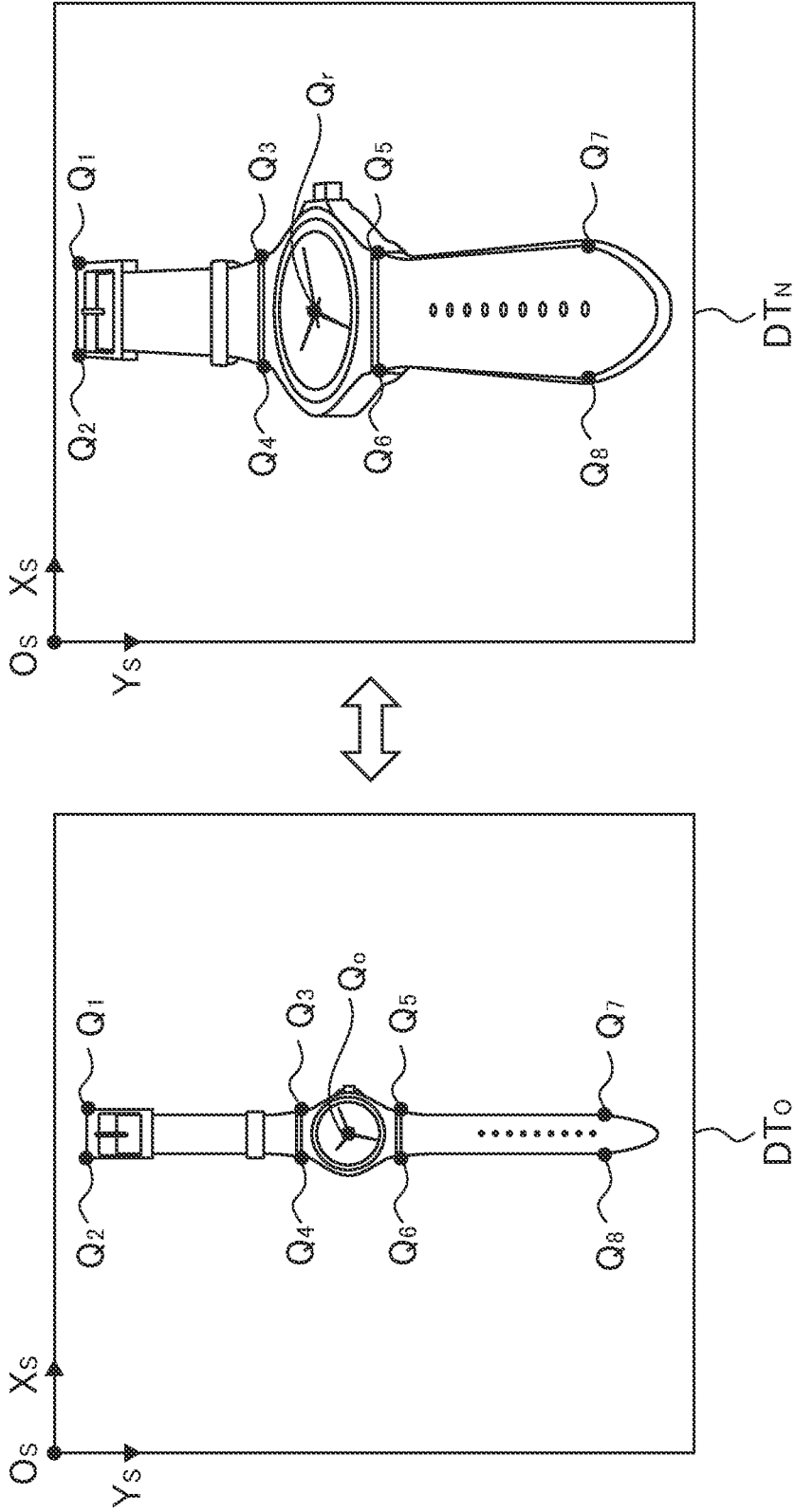
FIG.8
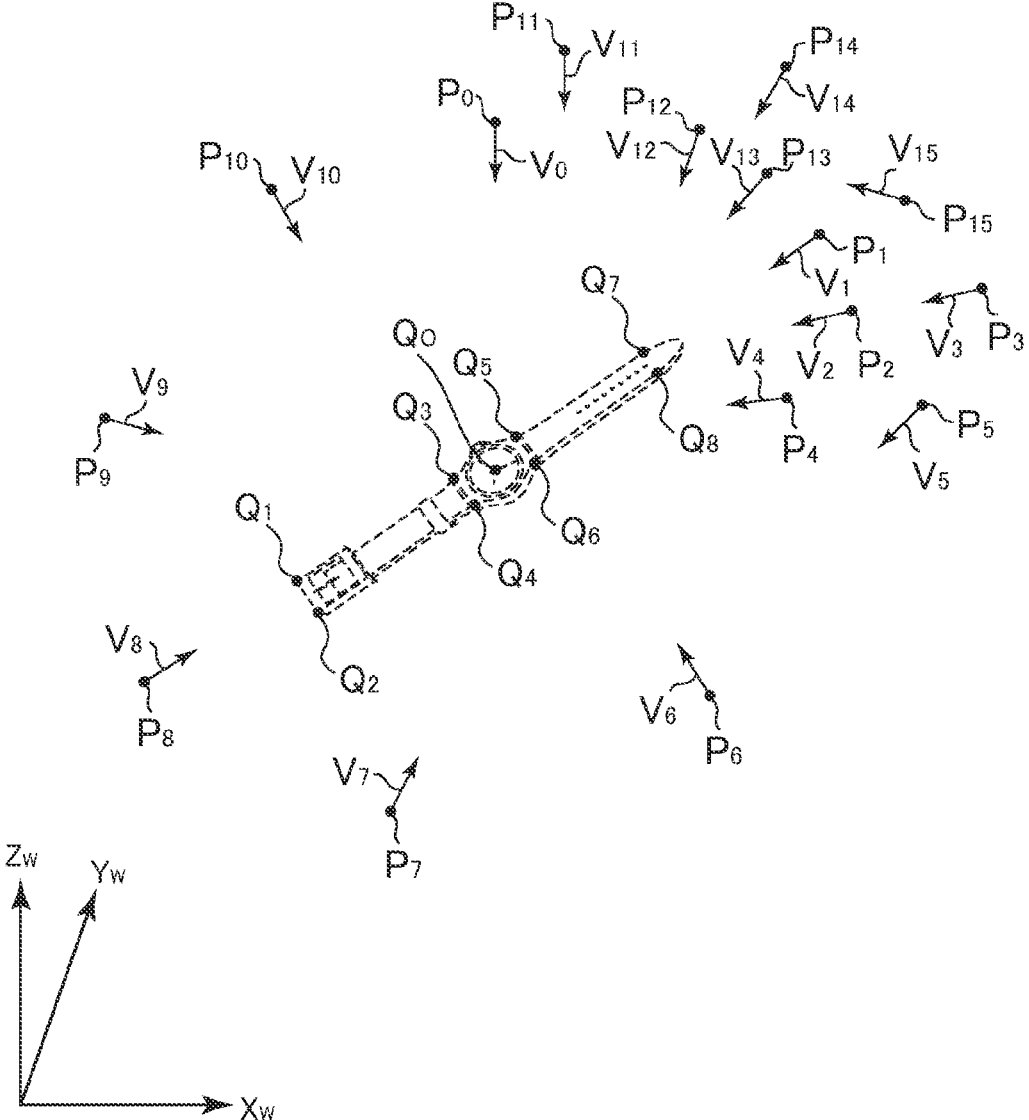
FIG.9

IMAGE DATA ID	PHOTOGRAPH INFORMATION		PHOTOGRAPHED FEATURE POINT ID
	PHOTOGRAPHING POSITION	PHOTOGRAPHING DIRECTION	
0	P_0	V_0	0,1,2,3,4,5,6,7,8
1	P_1	V_1	0,1,2,3,4,5,6,7,8
2	P_2	V_2	0,1,2,3,4,5,7,8
3	P_3	V_3	0,1,2,3,4,5,6,7,8
4	P_4	V_4	0,1,2,3,4,5,6,7,8
5	P_5	V_5	0,1,2,3,4,5,6,7,8
6	P_6	V_6	0,1,2,3,4,5,6,7,8
7	P_7	V_7	1,2,3,4,5,6,7,8
8	P_8	V_8	0,1,2,3,4,5,6,7,8
9	P_9	V_9	0,1,2,3,4,5,8
10	P_{10}	V_{10}	0,2,3,4,5,7,8
11	P_{11}	V_{11}	0,1,2,4,5,6,7,8
12	P_{12}	V_{12}	0,1,2,3,4,5,6,7,8
13	P_{13}	V_{13}	0,1,2,3,4,5,6,7,8
14	P_{14}	V_{14}	0,1,2,3,4,5,6,7,8
15	P_{15}	V_{15}	0,1,2,3,4,5,6,7,8

FIG.10

FEATURE POINT ID	THREE-DIMENSIONAL COORDINATES
0	X_{W0} , Y_{W0} , Z_{W0}
1	X_{W1} , Y_{W1} , Z_{W1}
2	X_{W2} , Y_{W2} , Z_{W2}
3	X_{W3} , Y_{W3} , Z_{W3}
4	X_{W4} , Y_{W4} , Z_{W4}
5	X_{W5} , Y_{W5} , Z_{W5}
6	X_{W6} , Y_{W6} , Z_{W6}
7	X_{W7} , Y_{W7} , Z_{W7}
8	X_{W8} , Y_{W8} , Z_{W8}

FIG.11

FIG.12

FIG.13

SELLER TERMINAL

DISPLAY CONTROL SERVER

BIDDER TERMINAL

S1
SEND IMAGE DATA ETC.

FINISH

S2
STORE IMAGE DATA ETC.

S3
DETECT FEATURE POINTS IN EACH IMAGE DATA PIECE

S4
OBTAIN PHOTOGRAPH INFORMATION OF EACH IMAGE DATA PIECE

S5
OBTAIN THREE-DIMENSIONAL COORDINATES OF EACH FEATURE POINT

S6
SEND REQUEST FOR DISPLAYING ITEM SCREEN

S7
GENERATE AND SEND DISPLAY DATA OF ITEM SCREEN

DISPLAY REQUEST OPERATION

S10
CONTENT OF OPERATION?

BIDDING OPERATION

S8
DISPLAY ITEM SCREEN

S11
SPECIFY FEATURE POINT DESIGNATED BY BIDDER

S17
EXECUTE BIDDING PROCESSING

S9
SEND RECEIVED OPERATION

S12
CALCULATE ORBIT INFORMATION

S15
CONTINUOUSLY DISPLAY IMAGE DATA PIECES

S13
SELECT IMAGE DATA PIECE

S16
FINISH?

NO

S14
GENERATE AND SEND CONTINUOUS DISPLAY DATA

YES

FINISH

FINISH

FINISH
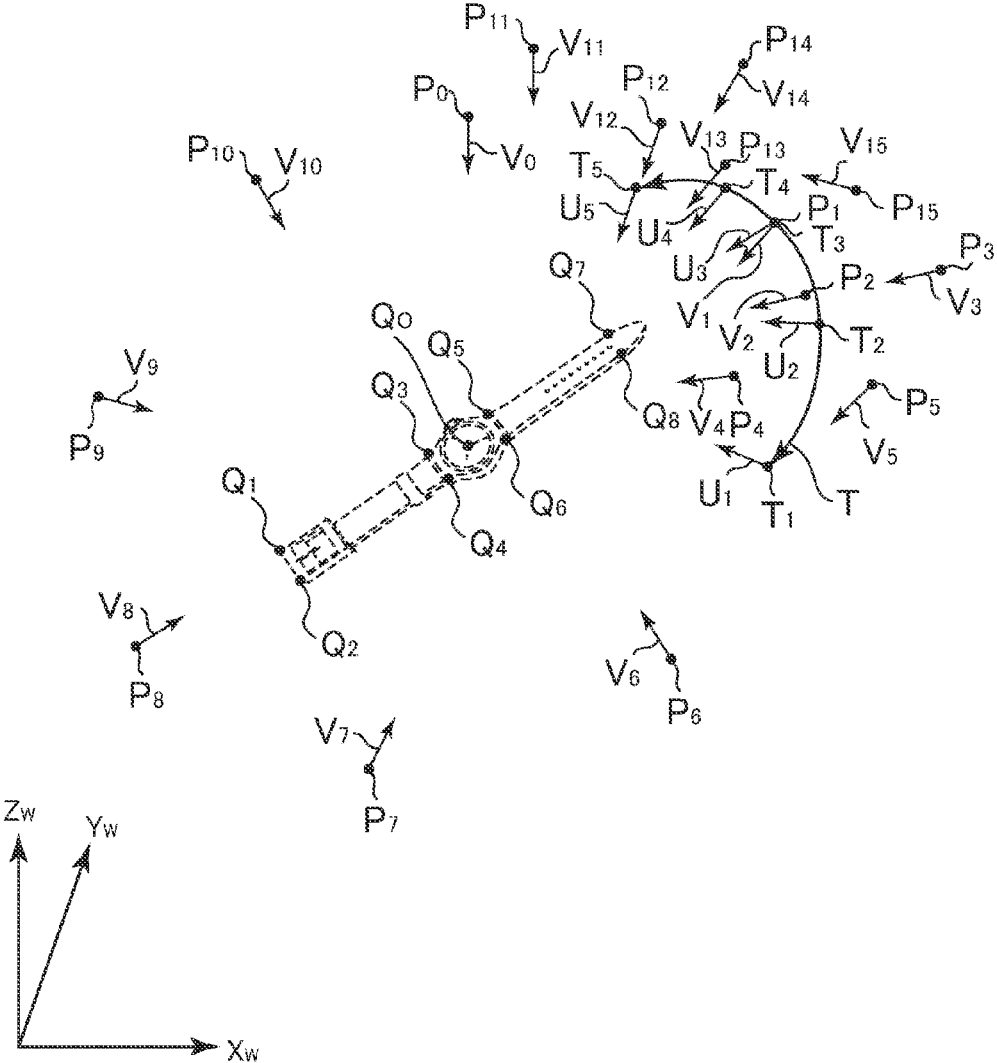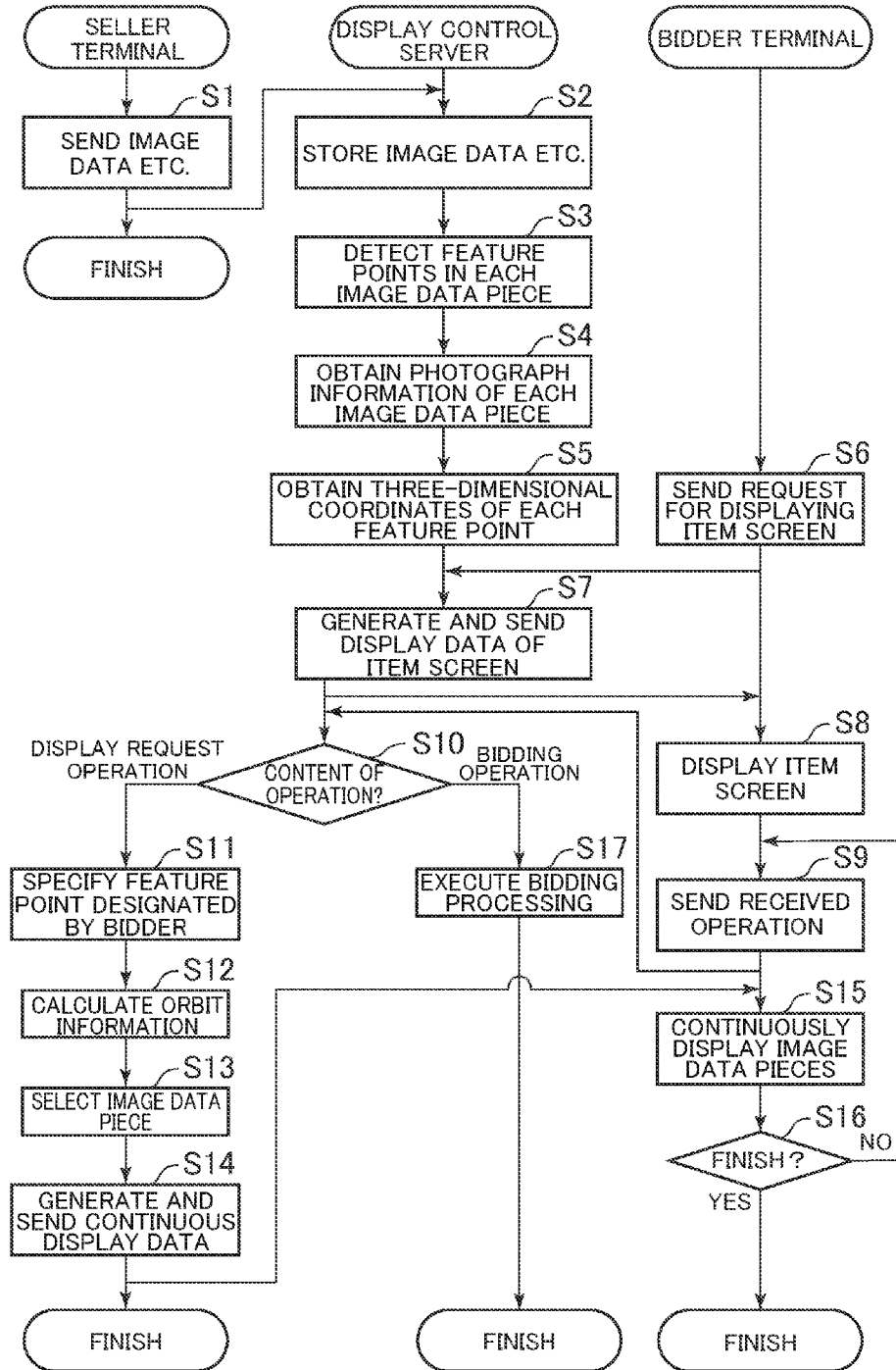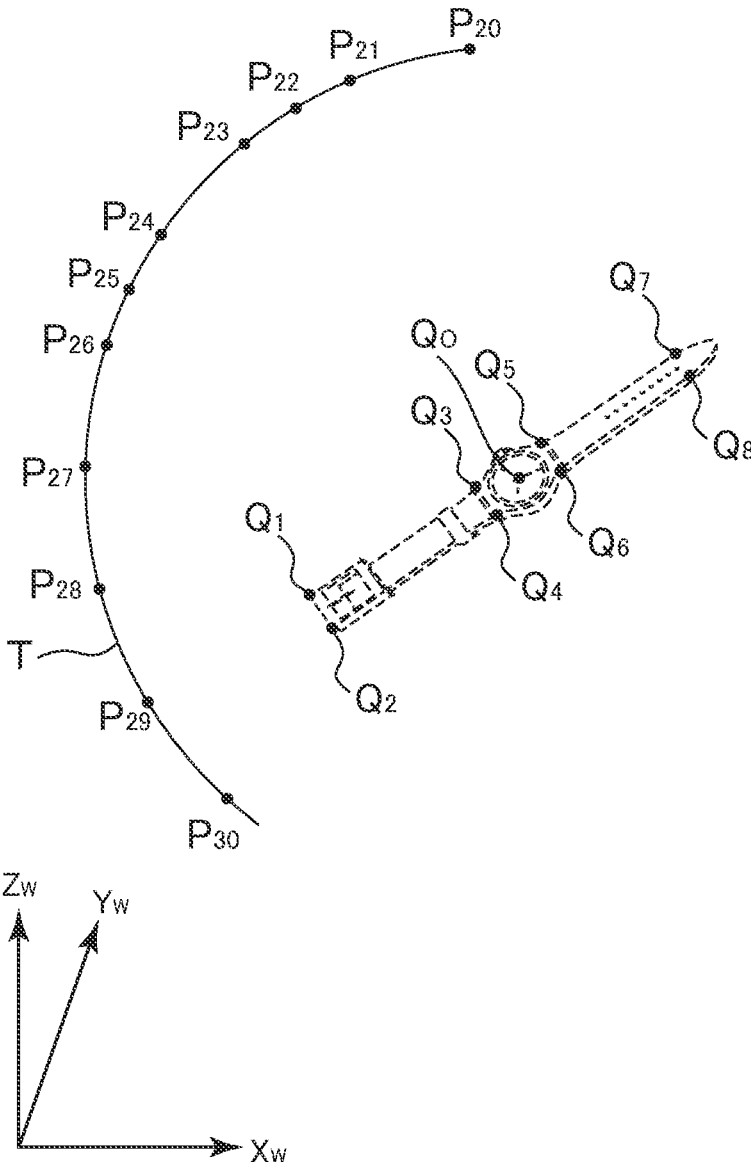
FIG.14

DISPLAY CONTROL SYSTEM, DISPLAY CONTROL DEVICE, DISPLAY CONTROL METHOD, AND PROGRAM

TECHNICAL FIELD

[0001] The present invention relates to a display control system, a display control device, a display control method, and a program.

BACKGROUND ART

[0002] A technique for accurately presenting condition of an object by shooting the object from various positions has been known. For example, Patent Literature 1 describes serially photographing by a camera an object on a turn table that turns at a predetermined speed, and displaying a video photographed by the camera on a display unit.

CITATION LIST

Patent Document

[0003] Patent Literature 1: JP2012-124745A

SUMMARY OF INVENTION

Technical Problem

[0004] However, conventionally, images are displayed only along with an orbit on which the object is photographed by the camera, and thus the orbit of the camera actually photographing the object needs to be the same as the orbit of a viewpoint on the display unit. As such, in order that the display unit displays images of the object viewed from the viewpoint moving along various orbits, the object needs to be photographed by moving the camera by the number of orbits, which takes a lot of labor.

[0005] One or more embodiments of the present invention have been conceived in view of the above, and an object thereof is to provide a display control system, a display control device, a display control method, and a program capable of reducing labor of photographing an object in a case where images of the object viewed from a viewpoint moving along with an orbit are displayed.

Solution to Problem

[0006] In order to solve the above described problems, a display control system according to the present invention includes image obtaining means for obtaining a plurality of image data pieces generated by photographing an object from a plurality of photographing positions that are different from one another in photographing directions, information obtaining means for obtaining photograph information relating to the photographing positions of the respective image data pieces in a three-dimensional space based on the image data pieces, image selecting means for selecting some of the image data pieces based on the photograph information of the respective image data pieces and orbit information relating to an orbit of a viewpoint that moves while changing a viewing direction in the three-dimensional space, and display control means for displaying, on display means, the image data pieces selected by the image selecting means in an order according to the orbit.

[0007] The display control device according to the present invention includes information obtaining means for obtain-

ing content stored in storage means that stores a plurality of image data pieces and photograph information in association with one another, the plurality of image data pieces being generated by photographing an object from a plurality of photographing positions that are different from one another in photographing directions, and the photograph information being related to the photographing positions of the respective image data pieces in a three-dimensional space, image selecting means for selecting some of the image data pieces based on the photograph information of the respective image data pieces and orbit information relating to an orbit of a viewpoint that moves while changing a viewing direction in the three-dimensional space, and display control means for displaying, on display means, the image data pieces selected by the image selecting means in an order according to the orbit.

[0008] A display control method according to the present invention includes an image obtaining step for obtaining a plurality of image data pieces generated by photographing an object from a plurality of photographing positions that are different from one another in photographing directions, an information obtaining step for obtaining photograph information relating to the photographing positions of the respective image data pieces in a three-dimensional space based on the image data pieces, an image selecting step for selecting some of the image data pieces based on the photograph information of the respective image data pieces and orbit information relating to an orbit of a viewpoint that moves while changing a viewing direction in the three-dimensional space, and a display control step for displaying, on display means, the image data pieces selected in the image selecting step in an order according to the orbit.

[0009] A program according to the present invention causes a computer to function as information obtaining means for obtaining content stored in storage means that stores a plurality of image data pieces and photograph information in association with one another, the plurality of image data pieces being generated by photographing an object from a plurality of photographing positions that are different from one another in photographing directions, and the photograph information being related to the photographing positions of the respective image data pieces in a three-dimensional space, image selecting means for selecting some of the image data pieces based on the photograph information of the respective image data pieces and orbit information relating to an orbit of a viewpoint that moves while changing a viewing direction in the three-dimensional space, and display control means for displaying, on display means, the image data pieces selected by the image selecting means in an order according to the orbit.

[0010] An information storage medium according to the present invention is a computer-readable information storage medium that stores the program described above.

[0011] In an embodiment of the present invention, the display control system further includes orbit obtaining means for obtaining the orbit information based on three-dimensional coordinates designated by a user.

[0012] In an embodiment of the present invention, the display control system further includes feature point detecting means for detecting three-dimensional coordinates of a plurality of feature points regarding the object based on at least one of the image data pieces, and the orbit obtaining means obtains the orbit information based on three-dimen-

sional coordinates of a feature point designated by the user among from the plurality of feature points.

[0013]   In an embodiment of the present invention, the orbit obtaining means obtains the orbit information about the viewpoint that moves while fixating on the three-dimensional coordinates of the feature point designated by the user.

[0014]   In an embodiment of the present invention, the display control system further includes photograph determining means for determining whether the feature point designated by the user is photographed in the respective image data pieces based on the image data pieces, and the image selecting means selects some of the image data pieces based on the photograph information of the respective image data pieces, the orbit information, and a determination result of the photograph determining means.

[0015]   In an embodiment of the present invention, the photograph information of the respective image data pieces includes photographing position information of the respective image data pieces, the orbit information includes orbit position information of the viewpoint, and the image selecting means selects some of the image data pieces based on distances among positions indicated by the photographing position information of the respective image data pieces and positions indicated by the orbit position information.

[0016]   In an embodiment of the present invention, the photograph information of the respective image data pieces includes photographing direction information of the respective image data pieces, the orbit information includes viewing direction information about the viewpoint from the orbit, and the image selecting means selects some of the image data pieces based on deviations among directions indicated by the photographing direction information of the respective image data pieces and directions indicated by the viewing direction information.

[0017]   In an embodiment of the present invention, the image selecting means includes means for calculating evaluation values weighing the deviations more than the distances based on the distances and the deviations of the respective image data pieces, and selects some of the image data pieces based on the evaluation values of the respective image data pieces.

[0018]   In an embodiment of the present invention, the photograph information of the respective image data pieces includes the photographing position information of the respective image data pieces, and the image selecting means selects some of the image data pieces such that the distances of the positions indicated by the photographing position information of the respective image data pieces selected by the image selecting means are within a predetermined range based on the photographing position information of the respective image data pieces.

[0019]   In an embodiment of the present invention, the display control means determines at least either of display positions and display sizes of the respective image data pieces selected by the image selecting means such that at least either of a deviation of the display position and a deviation of the display size of the object displayed on the display means is within a predetermined range.

Advantageous Effects of Invention

[0020]   According to the present invention, it is possible to reduce labor of photographing images of an object in a case

where the images of the object viewed from a viewpoint moving along with an orbit are displayed.

BRIEF DESCRIPTION OF DRAWINGS

[0021]   FIG. 1 is a diagram illustrating an overall configuration of a display control system of this embodiment;

[0022]   FIG. 2 is a diagram illustrating a manner in which an seller photographs an item;

[0023]   FIG. 3 is a diagram illustrating an example of an item screen;

[0024]   FIG. 4 is a diagram illustrating a manner in which item images are continuously displayed;

[0025]   FIG. 5 is a block diagram showing an example of functions implemented in the display control system;

[0026]   FIG. 6 is a diagram illustrating a three-dimensional space;

[0027]   FIG. 7 is a diagram showing a comparison of two-dimensional coordinates of feature points;

[0028]   FIG. 8 is a diagram illustrating relationship among feature points and photograph information in the three-dimensional space;

[0029]   FIG. 9 is a diagram showing an example of data stored in a photograph information database;

[0030]   FIG. 10 is a diagram showing an example of data stored in a feature point database;

[0031]   FIG. 11 is a diagram explaining a calculating method of orbit information;

[0032]   FIG. 12 is a diagram illustrating relationship among photographing positions and photographing directions of image data pieces and an orbit;

[0033]   FIG. 13 is a flow chart showing an example of processing executed in the display control system; and

[0034]   FIG. 14 is a diagram illustrating relationship between the orbit and the photographing positions.

DESCRIPTION OF EMBODIMENTS

[1. Overall Configuration of Display Control System]

[0035]   An embodiment of the present invention will be described below in detail with reference to the accompanying drawings. This embodiment is described by example of a case in which a bidder checks image data of an item exhibited by a seller in an Internet auction.

[0036]   FIG. 1 is a diagram illustrating an overall configuration of a display control system in this embodiment. As shown in FIG. 1, the display control system 1 includes a display control server 10 (display control device), a seller terminal 20, and a bidder terminal 30. The display control server 10, the seller terminal 20, and the bidder terminal 30 are connected to one another through a network 2 so that data are mutually transmitted and received.

[0037]   The display control server 10 is a server computer. The display control server 10 includes a control unit 11, a storage unit 12, and a communication unit 13. The control unit 11 includes, for example, one or more microprocessors. The control unit 11 performs processing according to a program and data stored in the storage unit 12. The storage unit 12 includes a main storage unit and an auxiliary storage unit. For example, the main storage unit is a RAM, and the auxiliary storage unit is a hard disk or a solid-state drive. The communication unit 13 is a communication interface such as a network card. The communication unit 13 performs data communication through the network 2.

[0038] The seller terminal **20** is a computer operated by the seller, such as, a mobile phone (including smart phone), a portable information terminal (including tablet computer), or a personal computer. The seller terminal **20** includes a control unit **21**, a storage unit **22**, a communication unit **23**, an operation unit **24**, and a display unit **25**. The control unit **21**, the storage unit **22**, and the communication unit **23** respectively share the same hardware configuration with the control unit **11**, the storage unit **12**, and the communication unit **13**, and thus duplicated explanation will be omitted.

[0039] The operation unit **24** is an operating member for the seller to perform operation, and a pointing device such as a touch panel and a mouse. The operation unit **24** sends an operation of the seller to the control unit **21**. The display unit **25** is, for example, a liquid crystal display unit or an organic EL display unit. The display unit **25** displays a screen as indicated by the control unit **21**.

[0040] The seller terminal **20** is connected to a camera **26** through, for example, the communication unit **23**. The camera **26** is photographing means for photographing an object and generating image data, and is, for example, a digital camera or a mobile terminal with camera (smart phone and tablet terminal). The camera **26** inputs image data into the seller terminal **20**. The camera **26** may be included in the seller terminal **20**.

[0041] The bidder terminal **30** is a computer operated by the bidder. The bidder terminal **30** includes a control unit **31**, a storage unit **32**, a communication unit **33**, an operation unit **34**, and a display unit **35**. The bidder terminal **30** may share the same hardware configuration with the seller terminal **20**. The control unit **31**, the storage unit **32**, the communication unit **33**, the operation unit **34**, and the display unit **35** may be the same as the control unit **21**, the storage unit **22**, the communication unit **23**, the operation unit **24**, and the display unit **25**, respectively.

[0042] The program and the data are described as being stored in the storage unit **12**, the storage unit **22**, or the storage unit **32**, but may be provided to the storage unit **12**, the storage unit **22**, or the storage unit **32** through the network **2**. It is not necessary to be limited to the above-mentioned example, and, various types of computer hardware may be applied to the hardware configuration of the display control server **10**, the seller terminal **20**, and the bidder terminal **30**. For example, the display control server **10**, the seller terminal **20**, and the bidder terminal **30** may each comprise a reader (e.g., optical disc drive and memory card slot) for reading a computer-readable information storage medium. In this case, a program or data stored in an information storage medium may be provided to the storage unit **12**, the storage unit **22**, or the storage unit **32** through a reader.

[2. Overview of Processing in Display Control System]

[0043] Next, overview of the processing performed in the display control system **1** will be discussed. In this embodiment, when the seller exhibits an item in an Internet auction, the seller photographs the item using the camera **26** in order to inform the bidder of a condition of the item.

[0044] FIG. **2** illustrates a scene in which the seller photographs an item. As shown in FIG. **2**, the seller photographs the item with the camera **26** from various photographing positions while changing a positional relationship between the item and the camera **26**. In other words, the seller photographs the item while changing photographing direc-

tions of the camera **26**. The photographing direction is a direction toward a fixation point from the position of the camera **26**, and also a direction to which a lens of the camera **26** is directed.

[0045] The seller may photograph the item in still image mode for generating an image data piece one by one, or in moving image mode for generating moving image data including multiple images. The seller uploads image data together with exhibition related information, such as a description of the item, thereby exhibiting the item in an Internet auction. The bidder displays an item screen for bidding the item on the display unit **35** of the bidder terminal **30**.

[0046] FIG. **3** is a diagram illustrating an example of an item screen. As shown in FIG. **3**, the item screen **40** displays an item image **41**, thumbnail images **42**A to **42**C (hereinafter these are collectively referred to as thumbnail images **42**), and biding related information **43**, such as current price of the item. The item image **41** is one of the image data pieces uploaded by the seller. The thumbnail images **42** are generated by reducing the image data piece of the item image **41**.

[0047] The bidder can change the image data piece displayed on the item image **41** by selecting one of the thumbnail images **42**. Here, the image data piece indicated by the thumbnail image **42**A is displayed in the item image **41**. In this regard, thumbnail images **42** may be generated from all the image data pieces uploaded by the seller and displayed on the item screen **40**, or generated from only some of the image data pieces and displayed on the item screen **40**.

[0048] The bidder sees the item screen **40** to check the condition of the item. However, depending on the item image **41**, it is sometimes unable to fully check the desired parts due to lighting or photographing positions. As such, in the display control system **1**, when the bidder clicks on a part that the bidder especially wants to check in the item image **41** with a cursor **44**, the item images **41** are continuously displayed as if the camera **26** moves while fixating on such part.

[0049] FIG. **4** is a diagram illustrating a scene in which the item images **41** are continuously displayed. Here, a watch is exhibited as an example of an item, and FIG. **4** shows a case where the bidder clicks on a dial plate of the watch in the item image **41**. As shown in FIG. **4**, for example, the item images **41**A to **41**E are continuously displayed as if the camera **26** moves from left to right viewed from the front while fixating on the dial plate. In this way, the bidder can check the condition of the dial plate of the watch from various directions. In the following, details of the processing will be discussed.

[3. Functions Implemented in Display Control System]

[0050] FIG. **5** is a functional block diagram showing an example of functions implemented in the display control system **1**. As shown in FIG. **5**, in the display control system **1**, an image obtaining unit **50**, a feature point detecting unit **51**, an information obtaining unit **52**, a data storing unit **53**, an orbit obtaining unit **54**, a photograph determining unit **55**, an image selecting unit **56**, and a display control unit **57** are implemented. In this embodiment, a case is explained in which these functions are implemented in the display control server **10**. The image obtaining unit **50** is implemented mainly by the control unit **11** and the communication unit

13, the data storing unit **53** is implemented mainly by the storage unit **12**, and other functions are implemented mainly by the control unit **11**.

[0051] In this embodiment, the image obtaining unit **50**, the feature point detecting unit **51**, the information obtaining unit **52**, the data storing unit **53**, the orbit obtaining unit **54**, the photograph determining unit **55**, the image selecting unit **56**, and the display control unit **57** respectively correspond to image obtaining means, feature point detecting means, information obtaining means, storage means, orbit obtaining means, photograph determining unit, image selecting means, and display control means according to the present invention.

[3-1. Image Obtaining Unit]

[0052] The image obtaining unit **50** obtains a plurality of image data pieces that are generated by photographing the item from photographing positions that have different photographing directions from one another. As explained previously with reference to FIG. **2**, the photographing positions have different photographing directions to the item from one another. In this embodiment, the camera **26** generates each image data piece and inputs the generated image data piece into the seller terminal **20**. As such, the image obtaining unit **50** receives the plurality of image data pieces sent from the seller terminal **20** through the network **2**. The image obtaining unit **50** provides an image data piece with an image data ID, by which to uniquely identify the image data piece, and stores the image data piece in the data storing unit **53**.

[0053] When the camera **26** photographs an item in the moving image mode, the image obtaining unit **50** may obtain a plurality of image data pieces based on the moving image data. In this case, the image obtaining unit **50** extracts one of frames in the moving image data as one image data piece. In this case, the image obtaining unit **50** may extract image data pieces at predetermined frame intervals, or extract image data pieces for all of the frames.

[3-2. Feature Point Detecting Unit]

[0054] The feature point detecting unit **51** detects a plurality of feature points (in this embodiment, both of two-dimensional coordinates and three-dimensional coordinates) of the item based on a plurality of image data pieces. A feature point is a spot that is identifiable on the surface of the object by the computer, and for example, an outline or a corner of the object. The feature point is also described as an interest point or a vertex. Here, the feature point detecting unit **51** detects feature points in every image data piece obtained by the image obtaining unit **50**.

[0055] For example, the feature point detecting unit **51** extracts feature points using a corner detection method. As a corner detecting method, for example, Moravec corner detection or Harris corner detection may be used. For example, the feature point detecting unit **51** sets pixels in an image data piece as target pixels, detects an outline of the object from the difference between pixel values of the target pixels and peripheral pixels, and detects positions at the outline as feature points.

[0056] In this embodiment, the feature point detecting unit **51** labels feature points detected from each image data piece. For example, the feature point detecting unit **51** matches feature points of respective image data pieces, and deter-

mines if a feature point is a newly detected feature point or the same as the already detected feature point. The feature points may be matched based on pixel values of the feature points or positional relationship with other feature points. When a new feature point is detected from an image data piece, the feature point detecting unit **51** provides the feature point with a feature point ID to identify the feature point. When the same feature point as the already detected feature point is detected, the feature point detecting unit **51** does not provide the feature point with a feature point ID.

[0057] Here, the feature point detecting unit **51** stores, for every image data piece, feature point IDs of feature points detected from an image data piece and positions (two-dimensional coordinates in a screen coordinates system) of the feature points in the image in the data storing unit **53**. The information obtaining unit **52** described below uses two-dimensional coordinates of each feature point in order to obtain photograph information. The feature point detecting unit **51** also calculates three-dimensional coordinates of each feature point, and stores them in the data storing unit **53**, as subsequently described in detail.

[0058] For a detecting method of a feature point from image data, various known methods for detecting feature points can be applied. For example, the feature point detecting unit **51** may specify an area in the same color in an image data piece using blob analysis and determine the center of the area as a feature point, or detect a pixel of a predetermined pixel value (i.e., a pixel of a specified color) as a feature point. Alternatively, for example, the feature point detecting unit **51** may detect an entire outline of an object as a feature point.

[3-3. Information Obtaining Unit]

[0059] The information obtaining unit **52** obtains photograph information regarding a photographing position of each image data piece in a three-dimensional space based on a plurality of image data pieces. The photograph information comprises at least one of photographing position information and photographing direction information of an image data piece. The photographing position information is three-dimensional coordinates indicating a photographing position of an image data piece. The photographing direction information is vector information indicating a photographing direction of an image data piece or three-dimensional coordinates indicating a fixation point. Here, a case will be explained in which photographing direction information is vector information.

[0060] The information obtaining unit **52** obtains photograph information for each image data piece by analyzing each image data piece. Here, as an example of a method for obtaining photograph information, a method for using positional relationship of feature points will be discussed.

[0061] For example, assume that a seller photographs an item with a camera **26** at a reference photographing position in a reference photographing direction. In the following, an image data piece obtained in this way is referred to as a reference image data piece. For example, the reference image data piece is photographed from a position at a predetermined distance away from the item in a front direction. The reference photographing position and the reference photographing direction may be determined in advance. The information obtaining unit **52** first obtains the reference photographing position and the reference photographing direction in a three-dimensional space.

[0062] FIG. 6 is a diagram illustrating a three-dimensional space. As shown in FIG. 6, three axes (X_W axis, Y_W axis, Z_W axis) perpendicular to one another are set in the three-dimensional space. The information obtaining unit 52 obtains a photographing position P_0, which is away from the origin O_W in a predetermined direction (here, Z_W axis positive direction) by a predetermined distance, as a reference photographing position. The information obtaining unit 52 then obtains a photographing direction V_0, which indicates a negative direction of the Z_W axis, as a reference photographing direction.

[0063] The information obtaining unit 52 calculates photograph information of an image data piece based on positional relationship among two-dimensional coordinates of respective feature points of the image data piece and two-dimensional coordinates of respective feature points of the reference image data piece. For example, the information obtaining unit 52 calculates a photographing position P_N and a photographing direction V_N (N is a natural number) of an image data piece based on deviations of two-dimensional coordinates of respective feature points.

[0064] FIG. 7 is a comparison of two-dimensional coordinates of feature points. In FIG. 7, the reference image data piece is "DT_0", the image data piece to obtain the photograph information is "DT_N", and each feature point is shown as Q_K (K is a natural number and K=0 to 8 in FIG. 7). The information obtaining unit 52 obtains a vector connecting two-dimensional coordinates of respective feature points Q_K in the reference image data piece DT_0 to two-dimensional coordinates of respective feature points Q_K in the image data piece DT_N and performs predetermined matrix operations, thereby calculating a vector ΔV_1 indicating a deviation between the photographing positions P_0 and P_N and a vector ΔV_2 indicating a deviation between the photographing directions V_0 and V_N.

[0065] Referring back to FIG. 6, the information obtaining unit 52 sets a position shifted by the vector ΔV_1 from the photographing position P_0 as the photographing position P_N, and a direction shifted by the vector ΔV_2 from the reference photographing direction V_0 as the photographing direction V_N. The information obtaining unit 52 performs the same calculation for each image data piece so as to calculate photograph information, and stores the information in the data storing unit 53.

[0066] When the information obtaining unit 52 obtains the photograph information, the feature point detecting unit 51 detects three-dimensional coordinates of the feature points Q_K of the item based on at least one of the image data pieces. For example, the feature point detecting unit 51 calculates three-dimensional coordinates of the feature points Q_K by coordinate-transforming the two-dimensional coordinates of the feature points Q_K of the reference image data piece DT_0 based on the photographing position P_0 and the photographing direction V_0. The three-dimensional coordinates of respective feature points calculated by the feature point detecting unit 51 are stored in the data storing unit 53.

[0067] FIG. 8 is a diagram representing relationship among feature points and photograph information in the three-dimensional space. For example, in a case where 16 image data pieces including the reference image data piece are uploaded, as shown in FIG. 8, the information obtaining unit 52 obtains photographing positions P_0 to P_{15} and photographing directions V_0 to V_{15} of respective image data pieces, and the feature point detecting unit 51 detects feature points Q_0 to Q_8. The positional relationship among the photographing positions P_0 to P_{15} and the photographing directions V_0 to V_{15} with respect to the feature points Q_0 to Q_8 corresponds to the positional relationship among the photographing positions and the photographing directions of the camera 26 when the item was photographed by the bidder.

[0068] For a method of obtaining photograph information, various known methods can be applied. For example, the photograph information may be obtained not by using the reference image data piece, but by comparing image data pieces. Alternatively, for example, the display control server 10 may prepare an image data piece indicating a reference shape of the object in advance, and estimate the photograph information by detecting differences from the reference shape in size and direction.

[3-4. Data Storing Unit]

[0069] The data storing unit 53 stores various kinds of data necessary for displaying the item screen 40. For example, the data storing unit 53 stores image data pieces obtained by the image obtaining unit 50 in association with respective image data IDs. Further, the data storing unit 53 stores a photograph information database in which the photograph information obtained by the information obtaining unit 52 is stored and a feature point database in which the three-dimensional coordinates of the feature points Q_K calculated by the feature point detecting unit 51 are stored.

[0070] FIG. 9 is a diagram illustrating an example of data stored in the photograph information database. As shown in FIG. 9, the photograph information database stores image data IDs, photograph information (photographing positions P_N and photographing directions V_N), and feature point IDs in association with one another. Here, the feature point IDs indicate the feature points detected in the image data pieces having the image data IDs among all of the feature points. For example, all of feature points Q_0 to Q_8 are detected in the reference image data piece having an image data ID "0", and the feature point Q_6 is not detected in the image data piece having an image data ID "2" due to, for example, reflection of light. Although omitted in FIG. 9, two-dimensional coordinates of feature points in image data pieces may be stored in association with feature point IDs.

[0071] FIG. 10 is a diagram illustrating an example of data stored in the feature point database. As shown in FIG. 10, the feature point database stores feature point IDs and three-dimensional coordinates of feature points Q_K in association with one another. In this embodiment, three-dimensional coordinates of feature points Q_K are the same in respective image data pieces, and thus are stored in the feature point database, and two-dimensional coordinates of feature points Q_K differ for respective image data pieces, and thus are stored in the photograph information database.

[0072] The data storing unit 53 may store data other than described above. For example, the data storing unit 53 may store data of thumbnail images of image data pieces, exhibition related information, and biding related information. Further, the information obtaining unit 52 may be capable of obtaining content stored in the data storing unit 53.

[3-5. Orbit Obtaining Unit]

[0073] The orbit obtaining unit 54 obtains orbit information regarding an orbit of a viewpoint that moves while

changing a viewing direction in the three-dimensional space based on at least either of the bidder's operation and the orbit calculation algorithm. The orbit calculation algorithm is written in a program, and includes a numerical expression for calculating the orbit. The orbit may be determined only by the bidder's operation, or only by the orbit calculation algorithm, although in this embodiment, a case in which the orbit is determined based on both of these cases will be discussed.

[0074] The viewpoint in the three-dimensional space is a viewpoint on the item screen **40** (i.e., a viewpoint on a viewer), and also can be described as a virtual camera in the three-dimensional space. The orbit of the viewpoint is a change in the position of the viewpoint or the viewing direction. The orbit of the viewpoint has a start point and an end point. The start point and the end point may be different positions from each other, or the same position. The orbit of the viewpoint may be described as a path moving from the start point to the end point.

[0075] The orbit information includes at least either of orbit position information of the viewpoint and viewing direction information of the viewpoint from the orbit. In this embodiment, the orbit information includes both of the orbit position information and the viewing direction information, but may include only one of them.

[0076] The orbit position information indicates changes in positions of the viewpoint in the three-dimensional space. For example, the orbit position information may include three-dimensional coordinates of each position on the orbit, or a numerical expression indicating the orbit. The viewing direction information indicates changes in viewing directions in the three-dimensional space. For example, the viewing direction information may include vectors indicating viewing directions of respective positions on the orbit, or three-dimensional coordinates indicating fixation points at the respective positions.

[0077] In this embodiment, the orbit obtaining unit **54** obtains the orbit information based on the three-dimensional coordinates designated by the bidder. For example, the orbit obtaining unit **54** obtains the orbit information based on the three-dimensional coordinates of the feature point Q_K designated by the bidder among the plurality of feature points Q_K. The bidder designates a position in the item image **41** on the item screen **40**, thereby designating the feature point Q_K.

[0078] Here, an example is explained in which the image data piece having an image data ID "1" is displayed in the item image **41**, and the bidder designates a part around the dial plate in the item image **41**. The orbit obtaining unit **54** obtains the two-dimensional coordinates designated by the bidder, and specifies the feature point Q_K in the vicinity thereof. Here, the orbit obtaining unit specifies the feature point Q_0 assuming that the bidder designated the feature point Q_0 on the dial plate of the watch. Then, the orbit obtaining unit **54** calculates the orbit information based on the photograph information of the image data piece and the specified feature point Q_0.

[0079] FIG. **11** is a diagram for explaining a calculating method of orbit information. The calculating method described below is defined in the orbit calculation algorithm. The orbit obtaining unit **54** first calculates a rotation axis L_2 perpendicular to a line L_1 connecting the photographing position P_1 of the image data piece having the image data ID "1" to the feature point Q_0. As shown in FIG. **11**, the rotation axis L_2 passes through the feature point Q_0. The orbit

obtaining unit **54** calculates orbit T through which the photographing position P_1 passes when the photographing position P_1 is rotated by a predetermined angle θ left and right (horizontal direction when the feature point Q_0 is viewed from the photographing position P_1) with the rotation axis L_2 as a reference.

[0080] Although there are a plurality of straight lines that are perpendicular to the line L_1 and pass through the feature point Q_0, any one of these straight lines may be defined as the rotation axis L_2. For example, the orbit obtaining unit **54** may determine the rotation axis L_2 based on a direction designated by the bidder in the three-dimensional space. For example, the bidder uses the operation unit **34** to designate a direction in which the photographing position P_1 rotates. The orbit obtaining unit **54** then specifies the rotation axis L_2 perpendicular to the direction designated by the bidder. For example, in a case where the bidder designates a horizontal direction when the feature point Q_0 is viewed from the photographing position P_1, as shown in FIG. **11**, the orbit obtaining unit **54** specifies the rotation axis L_2 that is perpendicular to the line L_1, passes through the feature point Q_0, and is perpendicular to the horizontal direction designated by the bidder. The orbit obtaining unit **54** may specify the rotation axis L_2 based not on the direction designated by the bidder, but on the predetermined direction. When the predetermined direction is a horizontal direction, as shown in FIG. **11**, the orbit obtaining unit **54** specifies the rotation axis L_2 that is perpendicular to the line L_1, passes through the feature point Q_0, and is perpendicular to the horizontal direction, which is the predetermined direction.

[0081] For example, the orbit position information includes three-dimensional coordinates of a plurality of points T_M (M is a natural number, and M=1 to 5 in FIG. **11**) on the orbit T. Here, point T_1 is a start point and point T_5 is an end point. Each point T_M is a position of a viewpoint in the three-dimensional space, and the orbit T is a path in which the viewpoint moves from the point T_1 to the point T_5. The orbit obtaining unit **54** calculates a viewing direction U_M of a viewpoint for each point T_M. Here, viewing directions U_1 to U_5 are directions respectively setting the feature point Q_0 as the fixation point from the points T_1 to T_5. The viewing direction information includes vector information of the calculated viewing directions U_M.

[0082] As described above, the orbit obtaining unit **54** obtains the orbit information of the viewpoint that moves in a way that the viewpoint is fixed on the three-dimensional coordinates of the feature point Q_0 designated by the bidder. In this regard, "the viewpoint that moves in a way that the viewpoint is fixed" means that the viewpoint changes its position (in FIG. **11**, from point T_1 to point T_5) while the fixation point of the viewpoint is kept at the feature point Q_0. In other words, the viewpoint changes its position while keeping the state in which the range of the viewpoint includes the feature point Q_0.

[3-6. Photograph Determining Unit]

[0083] The photograph determining unit **55** determines whether the feature point Q_K designated by the bidder is photographed in each image data piece based on the image data pieces. The photograph determining unit **55** refers to the photograph information database and determines whether the feature point Q_K designated by the bidder is detected in respective image data pieces.

[0084] The photograph determining unit **55** may specify an area occupied by the item in the three-dimensional space, and determine whether the area is comprised in the photographing range of the image data piece. In this case, the photograph determining unit first specifies the area occupied by the item in the three-dimensional space based on the three-dimensional coordinates of the feature points Q_K. For example, the photograph determining unit **55** specifies the interior of the three-dimensional space obtained by connecting each of the feature points Q_K as the area occupied by the item. The photograph determining unit **55** then determines whether the area occupied by the item is included in a visual field calculated based on photographing positions P_N and photographing directions V_N of respective image data pieces. The visual field is an area defined by a photographing position P_N, a photographing direction V_N, and a viewing angle (field angle). The viewing angle may be determined in advance, or calculated by analyzing an image data piece.

[3-7. Image Selecting Unit]

[0085] The image selecting unit **56** selects some of image data pieces based on photograph information of respective image data pieces and orbit information about an orbit T when a viewpoint in the three-dimensional space moves while changing a viewing direction. The image data pieces selected by the image selecting unit **56** are image data pieces that relate to the orbit information and should be displayed on the item screen **40**. The image selecting unit **56** selects the image data pieces based on differences (positional relationship) between the photograph information of respective image data pieces and the orbit information obtained by the orbit obtaining unit **54**.

[0086] For example, the image selecting unit **56** selects some of the image data pieces based on distances D_N between photographing positions P_N indicated by the photographing position information of respective image data pieces and positions T_M indicated by the orbit position information. For example, the image selecting unit **56** selects some of the image data pieces based on deviations θ_N among photographing directions V_N indicated in the photographing direction information of respective image data pieces and viewing directions U_M indicated in the viewing direction information. The deviation θ_N may represent a directional deviation, for example, an angle or a vector.

[0087] In this embodiment, a case is explained in which the image selecting unit **56** includes an evaluation value calculating unit **56A** that calculates evaluation values E_N obtained by weighting deviations θ_N more than distances D_N based on distances D_N and deviations θ_N of respective image data pieces, and selects some of the image data pieces based on the evaluation values E_N of the respective image data pieces. The evaluation value calculating unit **56A** corresponds to means for calculating evaluation values according to the present invention.

[0088] FIG. **12** is a diagram representing relationship among photographing positions P_N and photographing directions V_N of respective image data pieces, and the orbit T. For example, the evaluation value calculating unit **56A** calculates distances D_0 to D_{15} between each of photographing positions P_0 to P_{15} and the orbit T. Here, the orbit information stores three-dimensional coordinates of points T_1 to T_5 on the orbit T. As such, the evaluation value calculating unit

56A calculates the distances D_0 to D_{15} between each of the photographing positions P_0 to P_{15} and the nearest point among the points T_1 to T_5.

[0089] The evaluation value calculating unit **56A** calculates deviations θ_0 to θ_{15} among the photographing directions V_0 to V_{15} and the viewing directions U_1 to U_5 from the orbit T. Here, the orbit information stores the viewing directions U_1 to U_5 from the respective points T_1 to T_5 on the orbit T. As such, the evaluation value calculating unit **56A** calculates the deviations θ_0 to θ_{15} between each of photographing positions P_0 to P_{15} and the nearest direction among the viewing directions U_1 to U_5.

[0090] The evaluation value calculating unit **56A** substitutes the distances D_N and deviations θ_N calculated as described above for numerical expressions, thereby calculating evaluation values E_N of respective image data pieces. The evaluation value E_N may be described as similarity between the photograph information and the orbit information. In other words, the evaluation value E_N may be described as an index value indicating whether an image data piece should be displayed. Here, when a numerical value of an evaluation value E_N is higher, the photograph information and the orbit information have more similarities. That is, when a numerical value of an evaluation value E_N is higher, a degree to display an image data piece gets higher.

[0091] The numerical expressions used for calculating evaluation values E_N are written in the program. For example, the evaluation value calculating unit **56A** calculates an evaluation value E_N by substituting a distance D_N and a deviation θ_N for the following expression 1. As indicated in the expression 1, when the distance D_N and the deviation θ_N are smaller, the evaluation value E_N is greater. In the expression 1, a coefficient of the distance D_N is greater than a coefficient of the deviation θ_N. That is, the deviation θ_N is weighted more than the distance D_N.

$$E_N = C_D * (D_{MAX} - D_N) + C_\theta * (\theta_{MAX} - \theta_N) \qquad \text{(Expression 1)}$$

C_D, C_θ: predetermined coefficient. Here, $C_D < C_\theta$.

D_{MAX}: predetermined maximum value of distance D_{NM}.

θ_{MAN}: predetermined maximum value of deviation θ_{NM}.

[0092] In a case of positional relationship shown in FIG. **12**, for example, the image data pieces at the photographing positions P_0 and P_6 to P_{11} have large distances D_0 and D_6 to D_{11} and large deviations θ_0 and θ_6 to θ_{11}, and thus evaluation values E_0 and E_6 to E_{11} are small. On the other hand, at least either of the distances D_6 to D_{11} and the deviations θ_6 to θ_{11} of the image data pieces at the photographing positions P_1 to P_5 and P_{12} to P_{15} are small, and thus the evaluation values E_1 to E_5 and E_{12} to E_{15} are relatively large. In this regard, although the photographing positions P_2 and P_3 are photographed from the similar directions, the photographing position P_2 is closer to the orbit T, and thus the evaluation value E_2 is larger than the evaluation value E_3. Further, although between the photographing positions P_4 and P_5, P_5 is closer to the reference orbit T, the photographing direction V_5 is remarkably deviated from the reference viewing direction U_1, and thus evaluation value E_4 is larger than the evaluation value E_5. The image selecting unit **56** obtains a predetermined number of image data pieces in descending order of evaluation values E_N. For example, the image selecting unit **56** selects five image data pieces at the photographing positions P_4, P_2, P_1, P_{13}, and P_{12}.

[0093] The calculating method of evaluation values E_N is not limited to the above example. In this embodiment, the evaluation value E_N may be calculated by assigning more weights to the deviation θ_N than the distance D_N. For example, the evaluation value E_N may be calculated using other numerical expressions. This embodiment describes a case in which, when an evaluation value E_N is larger, a position T_M of a viewpoint and a viewing direction U_M have more similarities, although the way of using an evaluation value E_N is not limited to this example. A position T_M of a viewpoint and a viewing direction U_M may have more similarities when an evaluation value E_N is smaller. Similarities between a position T_M of a viewpoint and a viewing direction U_M may be determined in advance to be identifiable based on magnitudes of values. Further, an evaluation value E_N may be represented not only by a numerical value but also a word or a symbol.

[0094] The image selecting unit 56 may select some of the image data pieces based on the photograph information and the orbit information of respective image data pieces and the determination result of the photograph determining unit 55. The image selecting unit 56 selects image data pieces in which the feature point ID of the feature point Q_K designated by the bidder is stored as display target. For example, the image data pieces in which the feature point Q_K designated by the bidder is photographed are kept as the display target, and the image data pieces in which the feature point Q_K is not photographed are excluded from the display target. For example, when the bidder designates the feature point Q_0, the feature point Q_0 is not detected in the image data piece having the image data ID "7" in the example of data storage in FIG. 9 (e.g., when the entire dial plate is difficult to see due to reflections), and thus, such image data piece may be excluded from the display target in advance.

[3-8. Display Control Unit]

[0095] The display control unit 57 displays the image data pieces selected by the image selecting unit 56 on the display unit 35 in the order according to the orbit T. The order according to the orbit T is either of an order from the start point T_1 to the end point T_5 on the orbit T, and an order from the end point T_5 to the start point T_1 on the orbit T. The display control unit 57 provides the order to the image data pieces selected by the image selecting unit 56 in the order closer to the start point T_1 or the end point T_5. For example, in the above example of FIG. 12, the order of the image data IDs "4", "2", "1", "13", and "12" in the order closer to the viewpoint T_1 is the order according to the orbit.

[0096] For example, the display control unit 57 continuously displays (animation display) the image data pieces selected by the image selecting unit 56 in the order according to the orbit T. That is, the display control unit 57 displays the image data pieces selected by the image selecting unit 56 such that the image data pieces are switched in the order according to the orbit T. Here, the display control unit 57 continuously displays the image data pieces such that the image data pieces are switched in the order of the image data IDs "4", "2", "1", "13", and "12."

[4. Processing Executed in Display Control System]

[0097] FIG. 13 is a flow chart showing an example of processing executed in the display control system 1. The processing shown in FIG. 13 is executed when the control

units 11, 21, and 31 respectively operate according to the programs stored in the storage units 12, 22, and 32. In this embodiment, when the processing described below is executed, the functional blocks in FIG. 5 are implemented. When the processing described below is executed, assume that the seller photographs an item with the camera 26 as shown in FIG. 2, and image data pieces are stored in a memory of the camera 26.

[0098] As shown in FIG. 13, the control unit 21 of the seller terminal 20 sends the image data pieces stored in the memory of the camera 26 together with the exhibition related information to the display control server 10 through the communication unit 23 and the network 2 based on the operation received by the operation unit 24 (S1). In S1, the seller may be able to designate which one is the reference image data piece among the image data pieces.

[0099] The control unit 11 of the display control server 10 receives image data and exhibition related information and stores them in the storage unit 12 (S2). In S2, the control unit 11 provides image data pieces with respective image data IDs, and stores them in the storage unit 12. The control unit 11 may generate thumbnail image data of all or some of the received image data pieces, and store the generated data in the storage unit 12.

[0100] The control unit 11 detects feature points Q_K in respective image data pieces based on the image data pieces (S3). In S3, the control unit 11 obtains two-dimensional coordinates of feature points Q_K included in respective image data pieces, and stores them in the storage unit 12 in association with feature point IDs. The method for detecting a feature point Q_K was explained earlier.

[0101] The control unit 11 obtains photograph information of an image data piece based on feature points Q_K of the image data piece (S4). In S4, the control unit 11 obtains photograph information for each image data piece and registers the obtained photograph information in the photograph information database. The method for obtaining photograph information was explained earlier.

[0102] The control unit 11 obtains three-dimensional coordinates of each feature point Q_K (S5). In S5, the control unit 11 registers three-dimensional coordinates of each feature point Q_K in the feature point database. The method for obtaining three-dimensional coordinates of a feature point Q_K was explained earlier.

[0103] Preparation of exhibiting an item completes with the processing described above, and the bidder can bid the item. When the bidder uses the operation unit 34 of the bidder terminal 30 to perform a predetermined operation, the control unit 31 sends a request for displaying the item screen 40 to the display control server 10 (S6).

[0104] When the display control server 10 receives the request for displaying the item screen 40, the control unit 11 generates display data of the item screen 40, and sends the generated data to the bidder terminal 30 (S7). In S7, the control unit 11 reads an image data piece, a thumbnail image, and exhibition related information of the item, for example, from the storage unit 12, and generates the display data of the item screen 40. The display data may be data in a predetermined format, such as, HTML data.

[0105] When the bidder terminal 30 receives the display data, the control unit 31 displays the item screen 40 on the display unit 35 (S8). The control unit 31 sends the operation received at the item screen 40 (S9). Here, for simplicity, a case is explained in which a display request operation for

requesting continuous display of image data pieces and a bidding operation for bidding an item are received. The display request operation is performed by designating a position in the item image **41** with a cursor **44**. As such, information indicating the position designated by the cursor **44** is also sent to the display control server **10**. In S9, if an operation is not received in particular, the processing is finished.

[0106] When the display control server **10** receives an operation, the control unit **11** specifies content of the operation of the bidder (S10). When it is determined that the bidder has performed a display request operation (S10; display request operation), the control unit **11** specifies the feature point Q_K designated by the bidder based on the position designated by the bidder in the item image **41** (S11). In S11, the control unit **11** compares the two-dimensional coordinates designated by the bidder in the item image **41** with two-dimensional coordinates of respective feature points Q_K, and specifies a feature point Q_K that is closest to the two-dimensional coordinates designated by the bidder among from the all feature points Q_K.

[0107] The control unit **11** calculates orbit information based on the feature point Q_K specified in S11 (S12). In S12, the control unit **11** calculates an orbit T that moves while fixating on the feature point Q_K designated by the bidder. The method for calculating the orbit was explained earlier.

[0108] The control unit **11** selects some image data pieces based on the photograph information of the image data pieces and the orbit information calculated in S12 (S13). In S13, the control unit **11** calculates evaluation values E_N of respective image data pieces based on the photograph information and the orbit information of the image data pieces, and selects image data pieces in the order according to the orbit T. The method for selecting the image data pieces was explained earlier.

[0109] The control unit **11** generates continuous display data (moving image data) of the selected image data pieces, and sends the data to the bidder terminal **30** (S14). In S14, the control unit **11** generates the continuous display data such that the image data pieces are displayed in the order according to the orbit T. The continuous display data may be data in a predetermined format, such as GIF data.

[0110] When the bidder terminal **30** receives the continuous display data, the control unit **31** continuously displays the image data pieces on the display unit **35** (S15). The control unit **31** determines whether an ending condition is satisfied (S16). The ending condition is a condition for ending this processing, for example, a predetermined ending operation performed by the bidder. If it is determined that the ending condition is satisfied (S16; Y), this processing is finished. If it is determined that the ending condition is not satisfied (S16; N), the processing returns to S9.

[0111] On the other hand, in S10, it is determined that the bidder has performed a bidding operation (S10; bidding operation), the control unit **11** executes predetermined bidding processing and this processing is finished (S17). When the processing in S17 is executed, the bidder can bid the item.

[0112] According to the display control system **1** described above, the image data pieces selected based on the photograph information and the orbit information are displayed in the order according to the orbit T, which makes it unnecessary for the seller to photograph the item on various orbits with the camera **26**. As such, it is possible to reduce

labor of photographing an item when an item image **41** in which the item is viewed from a viewpoint moving along the orbit T is displayed. In addition, when an item exhibited in an Internet auction has fine scratches and soils, the item is displayed such that the item is viewed from various angles by continuously displaying the item images **41**, and thus it is possible to check the condition of the item more accurately. In a case where a three-dimensional model of the item is generated, the item can be viewed from various directions, although it takes labor to represent scratches and soils on the item in the three-dimensional model in order to accurately display the condition of the item. According to the display control system **1**, it is possible to provide the bidder with an actual condition of the item without taking such labor.

[0113] The orbit T is obtained based on the three-dimensional coordinates designated by the bidder, and thus the bidder can designate the orbit T of the viewpoint at which the bidder wants to view the item. As such, it is possible to display an image in a way that the viewpoint moves on the orbit T according to the bidder's preference. The orbit T is obtained based on the three-dimensional coordinates of the feature point Q_K designated by the bidder, and thus the bidder can designate the orbit T of the viewpoint at which the feature point Q_K that the bidder wants to view is photographed. As such, it is possible to display an image in a way that the position that the bidder wants to check can be viewed from various directions. Further, the bidder can check the feature point Q_K more easily by obtaining orbit information of the viewpoint that moves in a way that the three-dimensional coordinates of the feature point Q_K designated by the bidder is fixated. In addition, the bidder can check the feature point Q_K more easily by selecting the image data piece in which the feature point Q_K designated by the bidder is photographed, since in this way it is possible to display the image data piece in which the feature point Q_K designated by the bidder is clearly photographed.

[0114] The image data piece is selected based on the distance D_N, and thus it is possible to display the image data piece having the photographing position P_N closest to the orbit T. Further, the image data piece is selected based on the deviation θ_N, and thus it is possible to display the image data piece having the photographing direction V_N similar to the viewing direction U_M. In addition, in a case where a photographing position P_N is deviated, a view of an object varies greatly compared to a case where a photographing direction V_N is deviated. As such, the image data piece is selected based on the evaluation value weighing the deviation θ_N more than the distance D_N, and thus the image data piece can be selected in view of the smallness of the deviation θ_N.

[5. Variation]

[0115] The present invention is not to be limited to the above described embodiment and can be changed as appropriate without departing from the spirit of the invention.

[0116] (1) For example, when there are a plurality of image data pieces at the photographing position P_N that is close to the orbit T and intervals between the photographing positions P_N of the image data piece selected by the image selecting unit **56** are not consistent, the image data pieces are continuously and unnaturally displayed due to inconsistent changes in angles of the camera **26** to the item. As such, the image data pieces may be continuously and naturally dis-

played by setting the photographing positions P_N of the image data piece selected by the image selecting unit **56** at regular intervals.

[0117] FIG. **14** is a diagram illustrating relationship among an orbit T and photographing positions P_N. As shown in FIG. **14**, the photographing positions P_{20} to P_{30} are close to the orbit T, and evaluation values E_{20} to E_{30} of these photographing positions are also high. However, when all of image data pieces of the photographing positions P_{20} to P_{30} are continuously displayed, the photographing position P_{21}, for example, has narrower intervals between each of adjacent photographing positions P_{20} and P_{22} than other intervals. Similarly, the photographing position P_{25} has narrower intervals between each of adjacent photographing positions P_{24} and P_{26} than other intervals.

[0118] In view of this, the image selecting unit **56** of Variation (1) selects some of the image data pieces based on photographing position information of respective image data pieces, such that distances of the photographing positions P_N indicated by the photographing position information of the image data pieces selected by the image selecting unit **56** are within a predetermined range. Here, a case is explained in which the predetermined distance or longer corresponds to being within the predetermined range, although less than the predetermined distance may correspond to being within the predetermined range. Assume that information indicating the predetermined range is stored in the data storing unit **53** in advance.

[0119] Regarding an image data piece having a reference evaluation value E_N or more, the image selecting unit **56** calculates a distance between a photographing position P_{N1} of such image data piece and a photographing position P_{N2} of another image data piece that is closest to the photographing position P_{N1}. The image selecting unit **56** selects the image data piece as display target if the distance is within the predetermined range, and does not select the image data piece if the distance is not within the predetermined range. For example, in FIG. **14**, the image selecting unit **56** does not select image data pieces at the photographing positions P**22** and P**25**.

[0120] According to Variation (1), intervals between photographing positions P_N of image data pieces to be displayed are within a predetermined range, and thus the image data pieces can be displayed naturally.

[0121] (2) For example, the display control unit **57** may determine at least either of a display position and a display size of an image data piece selected by the image selecting unit **56** so that at least either of a deviation of the display position and a deviation of the display size of the item displayed on the display unit **35** is within a reference range. The display position is a position of the item in the image, and is, for example, two-dimensional coordinates of the feature point Q_K. The display size is a size occupied by the item in the image, and is, for example, the number of pixels by which the item is displayed.

[0122] The display control unit **57** determines a display position of an image data piece so that a deviation of the display position of the image data piece of the item selected by the image selecting unit **56** is within a reference range. For example, the display control unit **57** refers to the two-dimensional coordinates of the feature point Q_K of the image data piece, and changes the display position of the

image data piece so that the deviation of the position of the two-dimensional coordinates of the feature point Q_K is within the reference range.

[0123] The display control unit **57** determines a size of an image data piece so that a deviation of the display size of the image data piece of the item selected by the image selecting unit **56** is within a reference range. For example, the display control unit **57** changes the size of the image data piece so that the deviation of the ratio occupied by the item in the image data piece is within the reference range. For example, the display control unit **57** changes the size of the image data piece so that the size of the image data piece gets larger as the distance between the photographing position P_N of the image data piece and the feature point Q_K gets larger.

[0124] According to Variation (2), at least either of the deviation of the display position and the deviation of the display size of the image data piece of the displayed item is within the reference range, image data pieces can be naturally displayed in succession. The display control unit **57** may change both of the display position and the display size, or only one of them.

[0125] (3) For example, the embodiment explains a case in which the reference image data piece is an image data piece photographed by the seller at the photographing position that is a predetermined distance away from the item in the front direction, although the reference image data piece may be an image data piece designated by the seller among from the image data pieces to be uploaded to the display control server **10**. In this case, the photographing position and the photographing direction of the image data piece designated by the seller are the photographing position P_0, which is the reference photographing position, and the photographing direction V_0, which is the reference photographing direction, respectively.

[0126] For example, the reference image data piece may be selected from image data pieces by using a predetermined method. The reference image data piece may not necessarily be designated by the seller, for example, but may be an image data piece first photographed by the seller. For example, in a case where the image data piece first photographed by the seller is the reference image data piece and the camera **26** is moved to photograph an image such that a distance between the photographing position of the image data piece and the center point of the item is consistent, deviations of distances between the camera **26** and the item among the image data pieces are small. As such, the item images **41** can be continuously displayed on the item screen **40** in an easily viewable way. In this case, when the camera **26** photographs an image, a guide to photograph the image while keeping a predetermined distance from the center of the item may be displayed on the display unit of the camera **26**.

[0127] For example, when the image data pieces are selected as described in the embodiment by referring to FIG. **12**, the image data pieces of the photographing positions P_N that are respectively closest to the positions T_K are selected. As such, even though a deviation of each position from the orbit T is small, sometimes deviations among the photographing positions P_N of the image data pieces are large. In this case, as described in Variation (1), when the image data pieces are continuously displayed, they may be unnaturally displayed. As such, the image data pieces may be selected by using a method described below such that deviations among

the photographing positions P_N are reduced in order to achieve more natural continuous display.

[0128] The image selecting unit **56** specifies, based on a plurality of lines parallel to the orbit T, photographing positions P_N for the lines, respectively. Each line may be in a predetermined distance from the orbit T, for example, a distance within a predetermined percent of the size of the area occupied by the item in the three-dimensional space in a direction perpendicular to the orbit T. Further, the image selecting unit **56** may specify a photographing position P_N so that a distance to each line is within the predetermined distance, or calculate an evaluation value for each line by using a method similar to the method described in the embodiment. For example, the image selecting unit **56** may specify lines having the equal or more number of the photographing positions P_N specified as described above than the number of positions T_K on the orbit T (i.e., numerical value of K). Subsequently, the image selecting unit **56** selects a line based on intervals of the photographing positions P_N respectively specified for the lines (i.e., intervals along the lines) and distances between the lines and the orbit T. In selecting the lines, evaluation values (different from the evaluation value E_N described in the embodiment) may be calculated. Such evaluation values get higher as the deviations of intervals of the photographing positions P_N get smaller. Further, such evaluation values get higher as the distances between lines and the orbit T get smaller. The numerical expression for calculating such evaluation values may be written in the program in advance. For example, the image selecting unit **56** selects the line having the highest evaluation value. On this line, photographing positions P_N are aligned along the orbit T to some extent, and intervals among the photographing positions P_N are consistent to some extent. Subsequently, the image selecting unit **56** selects image data pieces of respective photographing positions P_N specified by the selected line.

[0129] For example, the display control unit **57** may display the image data pieces selected by the image selecting unit **56** in the order according to the orbit T. As such, other than continuous display, these image data pieces may be put in the order according to the orbit T to be displayed on the item screen **40**.

[0130] For example, in the description above, the image selecting unit **56** selects the predetermined number of image data pieces each having the evaluation value E_N equal to or more than the reference value, although all of the image data pieces each having the evaluation value E_N equal to or more than the reference value may be selected. The above describes a case in which the image selecting unit **56** calculates evaluation values E_N and selects image data pieces, although the image selecting unit **56** may select image data pieces using another method. For example, the image selecting unit **56** may select an image data piece with at least either of the distance D_N and the deviation θ_N being in the predetermined range.

[0131] For example, the above describes an example in which a user designates a feature point Q_K on the item screen **40**, although the user may designate a viewing direction U_M. In this case, the image selecting unit **56** may select an image data piece in a photographing direction V_N that is closest to the viewing direction U_M designated by the user. The image selecting unit **56** may select an image data piece having the smallest deviation from the photographing position P_N and the photographing direction V_N of the selected image data

piece as the image data piece to be displayed next. Subsequently, the image selecting unit **56** may select image data pieces in ascending order of deviation from the photographing position P_N and photographing direction V_N until the predetermined number of image data pieces are obtained.

[0132] For example, the method for obtaining the orbit information is not limited to the above described example. For example, the orbit information may be obtained without the need for the bidder to designate the feature point Q_K. In this case, the bidder may determine the orbit information by drawing a predetermined orbit on the item screen **40** using the operation unit **34**. For example, the display unit **35** may display an image indicating photographing positions P_N and photographing directions V_N of an image data piece (e.g., image indicating three-dimensional space as shown in FIG. **8**), and the orbit information may be obtained as the orbit drawn by bidder on the image.

[0133] For example, the above describes the case in which each function of the display control system **1** is implemented in the display control server **10**, although each function may be implemented in the bidder terminal **30**. In this case, the bidder terminal **30** corresponds to the display control device according to the present invention. For example, the functions may be shared among the display control server **10**, the seller terminal **20**, and the bidder terminal **30**. For example, the feature point detecting unit **51** and the information obtaining unit **52** may be implemented in the seller terminal **20**, and the seller terminal **20** may obtain feature points Q_K and photograph information, and upload the obtained feature points Q_K and photograph information together with the image data pieces to the display control server **10**. In this case, the feature point detecting unit **51** and the information obtaining unit **52** are implemented mainly by the control unit **21**. For example, the orbit obtaining unit **54** and the photograph determining unit **55** may be implemented in the bidder terminal **30**, and the bidder terminal **30** may obtain the orbit information and determine whether a feature point Q_K is photographed. In this case, the orbit obtaining unit **54** and the photograph determining unit **55** are implemented mainly by the control unit **31**. For example, the image selecting unit **56** and the display control unit **57** may be implemented in the bidder terminal **30**, and the bidder terminal **30** may select image data pieces and display the selected image data pieces on the item screen **40** in the order according to the orbit. In this case, the image selecting unit **56** and the display control unit **57** are implemented mainly by the control unit **31**.

[0134] For example, the processing of the display control system **1** has been described using an example in which the item screen **40** is displayed in an Internet auction, although the display control system **1** according to the present invention may be applied to various cases other than the Internet auction. For example, the processing similar to that of the display control system **1** may be applied to a SNS service in which users communicate with one another. The display control system **1** may be applied to a case where an image data piece in which an object is photographed from a plurality of positions is displayed. As such, an object may be any physical object besides an item. In the above description, "item" can be replaced with "object", and "seller" and "bidder" can be replaced with "user."

The invention claimed is:

1. A display control system comprising at least one processor, wherein the at least one processor:

obtains a plurality of image data pieces generated by photographing an object from a plurality of photographing positions that are different from one another in photographing directions;

obtains photograph information relating to the photographing positions of the respective image data pieces in a three-dimensional space based on the image data pieces;

obtains orbit information relating to an orbit of a viewpoint that moves while changing a viewing direction in the three-dimensional space based on three-dimensional coordinates designated by a user;

selects some of the image data pieces based on the photograph information of the respective image data pieces and the orbit information; and

displays, on a display, the selected image data pieces in an order according to the orbit.

2. (canceled)

3. The display control system according to claim 1,

wherein the at least one processor detects three-dimensional coordinates of a plurality of feature points regarding the object based on at least one of the image data pieces, and

obtains the orbit information based on three-dimensional coordinates of a feature point designated by the user among from the plurality of feature points.

4. The display control system according to claim 3,

wherein the at least one processor obtains the orbit information about the viewpoint that moves while fixating on the three-dimensional coordinates of the feature point designated by the user.

5. The display control system according to claim 3,

wherein the at least one processor determines whether the feature point designated by the user is photographed in the respective image data pieces based on the image data pieces, and

selects some of the image data pieces based on the photograph information of the respective image data pieces, the orbit information, and a determination result.

6. The display control system according to claim 1,

wherein the photograph information of the respective image data pieces comprises photographing position information of the respective image data pieces,

wherein the orbit information comprises orbit position information of the viewpoint, and

wherein the at least one processor selects some of the image data pieces based on distances among positions indicated by the photographing position information of the respective image data pieces and positions indicated by the orbit position information.

7. The display control system according to claim 1,

wherein the photograph information of the respective image data pieces comprises photographing direction information of the respective image data pieces,

wherein the orbit information comprises viewing direction information about the viewpoint from the orbit, and

wherein the at least one processor selects some of the image data pieces based on deviations of directions indicated by the photographing direction information of the respective image data pieces from directions indicated by the viewing direction information.

8. The display control system according to claim 6,

wherein the photograph information of the respective image data pieces comprises photographing direction information of the respective image data pieces,

wherein the orbit information comprises viewing direction information about the viewpoint from the orbit, and

wherein the at least one processor selects some of the image data pieces based on deviations of directions indicated by the photographing direction information of the respective image data pieces from directions indicated by the viewing direction information, and

calculates evaluation values weighing the deviations more than the distances based on the distances and the deviations of the respective image data pieces, and selects some of the image data pieces based on the evaluation values of the respective image data pieces.

9. The display control system according to claim 1,

wherein the photograph information of the respective image data pieces comprises the photographing position information of the respective image data pieces, and

wherein the at least one processor selects some of the image data pieces such that the distances of the positions indicated by the photographing position information of the selected respective image data pieces are within a predetermined range based on the photographing position information of the respective image data pieces.

10. The display control system according to claim 1,

wherein the at least one processor determines at least either of display positions and display sizes of the selected respective image data pieces such that at least either of a deviation of the display position and a deviation of the display size of the object displayed on the display is within a predetermined range.

11. A display control device comprising at least one processor, wherein the at least one processor:

obtains content stored in a storage that stores a plurality of image data pieces and photograph information in association with one another, the plurality of image data pieces being generated by photographing an object from a plurality of photographing positions that are different from one another in photographing directions, and the photograph information being related to the photographing positions of the respective image data pieces in a three-dimensional space;

obtains orbit information relating to an orbit of a viewpoint that moves while changing a viewing direction in the three-dimensional space based on three-dimensional coordinates designated by a user;

selects some of the image data pieces based on the photograph information of the respective image data pieces and the orbit information; and

display, on a display, the selected image data pieces in an order according to the orbit.

12. A display control method comprising:

obtaining a plurality of image data pieces generated by photographing an object from a plurality of photographing positions that are different from one another in photographing directions;

obtaining photograph information relating to the photographing positions of the respective image data pieces in a three-dimensional space based on the image data pieces;

obtaining orbit information relating to an orbit of a viewpoint that moves while changing a viewing direction in the three-dimensional space based on three-dimensional coordinates designated by a user;

selecting some of the image data pieces based on the photograph information of the respective image data pieces and the orbit information; and

displaying, on a display, the selected image data pieces in an order according to the orbit.

13. A non-transitory computer-readable information storage medium having stored thereon a program for causing a computer to:

obtain content stored in a storage that stores a plurality of image data pieces and photograph information in association with one another, the plurality of image data pieces being generated by photographing an object from a plurality of photographing positions that are different from one another in photographing directions, and the photograph information being related to the photographing positions of the respective image data pieces in a three-dimensional space;

obtain orbit information relating to an orbit of a viewpoint that moves while changing a viewing direction in the three-dimensional space based on three-dimensional coordinates designated by a user;

select some of the image data pieces based on the photograph information of the respective image data pieces and orbit information relating to an orbit of a viewpoint that moves while changing a viewing direction in the three-dimensional space; and

display, on a display, the selected image data pieces in an order according to the orbit.

* * * * *