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IMAGE EDITING DEVICE AND METHOD

The present invention relates to an image editing device and method for editing
5 images. More particularly, this invention relates to a device and a method for editing
images, including objects, using a time axis line.

Traditionally, in terms of authoring software to carry out the writing and editing of
image data or of game production software for creating games that include image data,
10 display technology has been provided for displaying on the same screen objects of
images to be edited and a time axis for the objects. In the editing of object data with
a time axis, it is necessary to edit while checking how the object at the current point
of time has changed from the object at a previous (past) point of time, or how it will
proceed to change at a forward (future) point of time. To achieve this a technique,
15 referred to as the "Onion Skin" technique has become available, in which the objects
of continuous frames leading to the past or future from a point of time are displayed
with a slight amount of transparency superimposed, and a time bar can be operated
to successively display the object at any point of time from the past or future
superimposed with the object at other points in time.

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In addition, in terms of editing of key frame objects, editing techniques involving the
saving or setting of attributes that objects possess between two desired key frames are
available. That is to say, in editing objects based on key frames, a method has been
employed of saving the data of one of the attributes of an object between two key
25 frames, for example, position, and applying said saved data to another object. As
determining movement is complicated and difficult in creating animation and a skilled
technique is required to set the same movement, it is convenient to apply to other
objects movement that has already been set once. However, flexibility is lacking with
the known method since the interval for saving the attributes is restricted to that from
30 the beginning to the end of the object, and also because, as far as attributes are
concerned, it is restricted to the existing attributes the object possesses.



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Moreover, in the editing and browsing operations for the authoring systems that carry out writing and editing of the image data, editing operations and browsing techniques have been provided that preserve the history of a series of operations. This editing technology preserves a record of operations during editing and browsing of the image data, and there are times when the editing and browsing operations done up to that point are carried out again. In this case, an operation is repeated by unconditionally returning to the immediately preceding operation by displaying it on a menu and designating it.

10 In editing objects on a key frame basis, technology has been provided for definition and editing with regard to the relationship between two or more objects. That is to say, in editing with a key frame basis, in the event that multiple objects are dealt with as a group, methods have been adopted for grouping objects on the display screen that is displaying the objects, thereby dealing with them together as a single object.

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In the editing of objects along the time axis of key frames, editing techniques have been provided that can group tracks set between key frames, or automatically carry out relative changes in the tracks set between the preceding and following key frames in accompaniment with changes in the key frames.

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With this editing technology and editing using key frames, after setting the values, for example, from key frame 1 to key frame 4 on the display screen that displays the key frames, there are times when the value of key frame 4 is changed when the track from key frame 1 to key frame 4 is maintained as is in relative terms. With the traditional system, after the tracks from key 1 to key 4 have been arranged as a group, a point corresponding to key 4 on the track for one entity may be moved by resetting a value of key 2 or key 3 manually or by using the display of the tracks on the editing screen. However, with this type of grouping, in the event that it is desired to change the value of key 2 after the grouping of key 1 to key 4, it has proved difficult to change the value of key 2 when the tracks between key 1 and key 2 and between key 2 and key 3 are maintained in the same relative positions.

In the editing of objects on a time axis line, since the editing is carried out keeping one time bar on the time axis and displaying only the object at the point of time for which it has been set, there is the drawback that it is difficult to check at the same time how the object has changed before and after that point of time.

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However, even with the Onion Skin method described above, when attempting to display the changes of another group of objects in the same space at the same time, one can use the transparency, but it is extremely difficult to discern the shapes of the objects at all of the points of time. As a result, it suffers the disadvantage of being
10 difficult to check the time changes of the targets being edited and of other related objects while editing.

Furthermore, in editing objects based on key frames, traditionally one of the attributes of the objects set between two key frames, for example the positional data, has been
15 saved, or the attribute is applied to another object. However, the data that could be saved consists of all of the attributes that an object possesses. In addition, in the application of the attributes, it has not been possible to designate a desired interval to which they could be applied.

20 Furthermore, in cases where an operational history is kept and editing and browsing operations are repeated, it has not been possible to display what the operations had been up to that point of time in a way that can be understood at a glance. Even though an operational history could be displayed by a menu as text, there have still been difficulties in knowing what operations had been carried out on the basis thereof.

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Also, when handling multiple objects grouped together as a single entity, methods such as grouping of objects have been used, but in cases where groups are formed, since all of the objects within the group are treated as a single entity, the carrying out of processing to cancel the grouping, change the position and re-form the group in
30 order to change the position of one of those objects has been extraordinarily cumbersome as well as complicated.

Further, the ability to set or change the attribute values, such as the positions occupied by the object, is only available for times corresponding to key frames. Accordingly changing the value of key frames at either end while maintaining the relative relationship of the values of the group set in the gap between one key frame and another is difficult. The difficulty is due to the fact that it is not possible to carry out an operation involving only the key frame being observed, since operations with respect to the other key frames or operations with respect to the objects displayed on the screen are also involved.

In accordance with the present invention there is provided an image editing device for editing images including objects related to a time axis, said device comprising:

means for displaying on the same screen a time axis display field showing a plurality of time bars which indicate times on the time axis and an object display field showing a plurality of objects;

means for adjusting the relative location of the time bars on the time axis;

control means for correlating the objects displayed in the object display field with the times indicated by the time bars; and a history control section for controlling historical information related to the history of a series of operations and for placing the said historical information into visual form for display by said display means.

The present invention also provides an image editing method for editing images including objects associated with a time axis, said method comprising the steps of :

displaying on the same screen a time axis display field showing a plurality of time bars which indicate times on the time axis and an object display field showing a plurality of objects;

adjusting the time bars relative to the time axis to selected said times;

correlating the objects displayed in the object display field with the times indicated by the time bars;

controlling historical information related to the history of a series of operations; and

placing the said historical information in its visual form for display.

The present invention further provides an image editing device for editing images associated with a time axis and including objects having attribute data comprising at least one of position, direction, size or angle data, said device comprising:

display means for displaying on the same screen the time axis display field showing a plurality of time bars which indicate times on a time axis and an object display field showing a plurality of objects;

means for adjusting the relative location of the time axis to select said times;

control means correlating the objects displayed in the object display field with the times indicated by the time bars;

intervals means for selecting intervals along the time axis of said objects;

attribute means for controlling attribute values of the intervals selected by said interval means; and

means for saving time and attribute data of said objects.

The present invention also provides an image editing method for editing images associated with a time axis and including objects having attribute data comprising at least one of position, direction size or angle data, said method including the steps of:

displaying on the same screen a time axis display field showing a plurality of time bars which indicate times on a time axis and an object display field showing a plurality of objects;

adjusting the time bars relative to the time axis to set said times;

correlating the objects displayed in the object display field with the times indicated by the time bars;

selecting intervals along the time axis of said objects;

controlling attribute values of the intervals selected by said interval means; and saving time and attribute data of said objects.

A preferred embodiment of the present invention is hereinafter described, by the way of example only, with reference to the accompanying drawings, wherein:

Fig. 1 is a block drawing showing the structure of an image editing device;

Fig. 2 is a drawing showing a first window and second window displayed on a display screen of the image editing device;

Fig. 3 is a block drawing that shows the internal control structure in the image editing device during editing of images using multiple time bars set on time axis;

Fig. 4 is a drawing showing a first object and a second object displayed in the

first window;

Fig. 5 is a drawing showing a time axis and a first time bar displayed in the second window;

Fig. 6 is a drawing showing the first object and the second object, which
5 correspond to the first time bar and the second time bar shown in the first window;

Fig. 7 is a drawing showing the first time bar and the second time bar displayed in the second window;

Fig. 8 is a drawing showing the status of the movement of the first object and the second object in the first window within this first window in response to the
10 movement of the second time bar along the time axis;

Fig. 9 is a drawing showing the first time bar on the time axis and the second time bar moving on the time axis in the second window;

Fig. 10 is a drawing showing the status in which the first object is fixed on the time axis and the second object being caused to move on the time axis in the first
15 window;

Fig. 11 is a drawing showing the first object which has been fixed and the second object which is moving in the first window;

Fig. 12 is a flow chart of a procedure related to the processing in the image editing device when a time bar has been caused to move;

20 Fig. 13 is a flow chart of a procedure related to the processing in the image editing device when a time bar has been added;

Fig. 14 is a block drawing showing the internal control structure when carrying out the saving or application of attributes along the time axis of a key frame in the image editing device;

25 Fig. 15 is a drawing showing the status in which the "Time Bar" button has been selected in the second window;

Fig. 16 is a drawing showing the status in which the "Start" button has been selected in the second window;

Fig. 17 is a drawing showing the status in which the "Time Bar" button has been
30 again selected in the second window;

Fig. 18 is a drawing showing the status in which the "End" button has been

selected in the second window;

Fig. 19 is a drawing showing the status in which the "Save" button has been selected in the second window;

Fig. 20 is a drawing showing the menu window that is in an overlapping display
5 in the second window shown in Fig. 19 when the "Save" button has been selected in the second window;

Fig. 21 is a drawing showing the pool window displayed when the "Confirmation" selection field is selected in the menu window shown in Fig. 20;

Fig. 22 is a drawing showing the pool window displayed in the window in
10 Fig. 21;

Fig. 23 is a drawing showing the status in which the "Time Bar" button has been selected in the second window;

Fig. 24 is a drawing showing the status in which the "Start" button has been selected in the second window;

15 Fig. 25 is a drawing showing the status in which the "Time Bar" button has again been selected in the second window;

Fig. 26 is a drawing showing the status in which the "End" button has been selected in the second window;

Fig. 27 is a drawing showing the status in which the attribute data from the pool
20 window shown in Fig. 22 have been dragged and dropped on the axis related to an object in the second window;

Fig. 28 is a drawing showing the menu window displayed in the window from Fig. 27 when the attribute data are being applied;

Fig. 29 is a drawing showing the status in which the operation of the application
25 of the attribute data in the window from Fig. 28 has been completed;

Fig. 30 is a flow chart showing a procedure to carry out processing related to the saving of attributes;

Fig. 31 is a flow chart showing a procedure to carry out processing related to the application of attributes;

30 Fig. 32 is a block diagram showing the internal control structure when the operational history of an object is visualized;

Fig. 33 is a drawing showing a substantially cube-shaped object displayed in the first window;

Fig. 34 is a drawing showing the view operation section displayed on the display screen of the image editing device;

5 Fig. 35 is a drawing showing the status in which there has been a change in the direction of viewing the cube object in the first window;

Fig. 36 is a drawing showing the view operation section in the status in which the direction of viewing the object has been changed;

Fig. 37 is a drawing showing the view direction of the object in the first window;

10 Fig. 38 is a flow chart of a procedure related to processing a change of view;

Fig. 39 is a flow chart of a procedure related to the processing of historical control of the operations;

Fig. 40 is a block drawing showing the internal control structure when carrying out hierarchical ordering;

15 Fig. 41 is a drawing showing the first object and the second object displayed in the first window;

Fig. 42 is a drawing showing the status of the first window when the second object, which has become semi-transparent, has been dragged by the cursor;

Fig. 43 is a drawing showing the status of the first window when the second
20 object, which has become semi-transparent, has been dragged by the cursor to the first object;

Fig. 44 is a drawing showing the first object, which is moving to the right from the left in the drawing within the first window, and the second object in this window which is following the direction of this first object;

25 Fig. 45 is a drawing of traditional hierarchical ordering and showing the first object and the second object;

Fig. 46 is a drawing of traditional hierarchical ordering and showing the first object and the second object, which have been grouped together;

Fig. 47 is a flow chart of a procedure related to the process of setting parent
30 objects;

Fig. 48 is a flow chart of a procedure related to the process of setting data

between objects;

Fig. 49 is a block diagram showing the internal control structure when the tracks set between key frames are grouped;

Fig. 50 is a drawing showing key frames and sub-key frames displayed in the first window;

Fig. 51 is a drawing showing the status when sub-key frames are caused to move in the window from the status in Fig. 50;

Fig. 52 is a drawing showing the status when a key frame at one end of the track is caused to move in the window from the status in Fig. 51;

Fig. 53 is a flow chart of a procedure related to the processing of changes of key frames and sub-key frames; and

Fig. 54 is a drawing of traditional processing of changes in tracks related to key frames.

15 An image editing device, as shown in Fig. 1, has a central processing section 1 that controls a series of procedures related to image editing and a memory section 2 that stores prescribed data under the control of the central processing section.

The central processing section 1 controls processing for the image editing device. The central processing section 1 follows processing procedures read from the memory section 2 to carry out processing vis-à-vis control data input from an input section 10 and outputting the data resulting from said processing to an output section 20. When carrying out a prescribed operation related to image editing, a control section is set up and the prescribed operation is carried out based on the control of the control section.

The memory section 2 is used for the writing in and reading out of data under the control of the central processing section 1 and storing data in memory. The memory section 2 arranges for the images related to the image editing to be written in temporarily and for the prescribed control section involved with image editing to be set up.

The image editing device has an input section 10 including a disk 11, a keyboard 12 and a pointing device 13. Data input by said input section 10 using the disk 11, keyboard 12 or pointing device 13 is transmitted to the central processing section 1.

- 5 The input section 10 allows the input of data for carrying out additions to, deletions from or movements of time for the images and time axes involved with an object, or such things as the shape, coordinates, color or light source at each time for a 3-dimensional computer graphics model (hereinafter referred to as "3DCG").
- 10 The disk 11 is a recording medium by which data is read, for example, magnetically, optically or optomagnetically. The disk 11 may be, for example, a CD-ROM or hard disk drive in which data is recorded. Prescribed data that has been recorded, for example, the shape and coordinate data for 3DCG models, can be read from the disk 11. The keyboard 12 is a standard input device which allows input of such things as
- 15 movements of, additions to and deletions from an image or a time axis corresponding to an object. The pointing device 13 is a standard device that inputs data related to position by correlating with the cursor displayed on a cathode ray tube (CRT) and can be provided by a mouse. Specifically, necessary data such as movements of, additions to or deletions from an image or a time axis corresponding to the object that is the
- 20 target item are input by the pointing device 13.

The image editing device also has an output section 20 including a disk 21, a CRT 22 and a printer 23. This output section 20 displays or stores the processing results with regard to an object and a time bar provided by the central processing device 1. The

25 disk 21 is a recording medium able to record data magnetically, optically or optomagnetically and, if desired, may also comprise the disk 11 of the input section 10. The CRT 22 is a graphic display that displays the data presented as images on a screen. The CRT 22, as shown, for example, in Fig. 2, is able to display a first window 22a, which is an object display field that contains objects, and a second window 22b,

30 which is a time bar display field, in which multiple time bars are set up. The printer 23 is a standard output device which can be used to print the results of processing with

regard to objects and time axes.

In editing of images including objects along a time axis, as shown in Fig. 2, the image editing device generates on the CRT 22 one window 22a that displays multiple objects
5 and another window 22b that has set time bars on a time axis, and the objects and time bars of these windows are handled by the operation of a mouse, which is the pointing device 13.

For image editing, key frames are used to produce animation where a key frame (also
10 referred to as "frame") is set at a desired time on a time axis and the attributes for an object corresponding to that time are set. Based on the values of the key frames set before and after that, a group of attribute values between the key frames is automatically produced through methods such as linear interpolation. Here, what is
meant by attribute value is a value that represents, for example, positional data.

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During such image editing, as shown in Fig. 3, the object control section 31, which exercises control over objects, the time bar control section 33, which exercises control over time bars and the object display control section 32, which exercises control over displays of objects, are set up as control blocks and are connected to one another.
20 The control blocks are established by the central processing section 1 executing corresponding control software stored in the memory section 2. The same holds true for the control blocks to be described hereinafter.

The object control section 31 establishes one 3DCG model as one object, and
25 maintains an object list to exercise control over matter such as which objects exist at which times. The time bar control section 33 carries out real time management to implement control over and display of time bars at the current point of time. Also, it exercises control over the creation and deletion of new time bars. The object display control section 32 receives time information from the time bar control section 33 and
30 receives a list of objects existing at times corresponding to the time information from the object control section 31. It gathers therefrom the necessary shape and coordinate

data on an object group to carry out rendering of an image.

The first window 22a, as shown in Fig. 4, is used to carry out editing along a time axis with regard to a first object OBJ 1 and a second object OBJ 2. The first object OBJ 1, a 7-pointed star figure displayed in solid lines, and the second object OBJ 2, a more or less equilateral triangle similarly displayed in solid lines, correspond to a time bar TB 1 at a second time t_2 in the second window 22b, as shown in Fig. 5. Furthermore, with regard to the first object OBJ 1' displayed in dotted lines and the second object OBJ 2' similarly displayed in dotted lines, these correspond to the first time bar TB 1' at a first time t_1 in the second window 22b in Fig. 5.

In Fig. 5, since the first time bar TB 1 is moved from the first time t_1 to the second time t_2 , the first object OBJ 1' and the second object OBJ 2' displayed in broken lines in Fig. 4 show positions prior to the movement corresponding to the first time bar TB 1' at the first time t_1 .

A first track TRJ 1 is displayed between the first object OBJ 1', which corresponds to the first time bar TB 1' at time t_1 , and the first object OBJ 1, which corresponds to the first time bar TB 1 at time t_2 . This first track TRJ 1 shows the route along which the first object OBJ 1 has moved in the gap from time t_1 to time t_2 .

The second track TRJ 2 is displayed between the second object OBJ 2', which corresponds to the first time bar TB 1' at time t_1 , and the second object OBJ 2, which corresponds to the first time bar TB 1 at time t_2 . This second track TRJ 2 shows the route along which the second object OBJ 2 has moved in the gap from time t_1 to time t_2 .

In the second window 22b, as shown in Fig. 5, shown in parallel in descending order from the top of the drawing are the time axis TA, axis A 1 corresponding to the first object OBJ 1 and axis A 2 corresponding to the second object OBJ 2, where the elapse of time increases horizontally across the windows 22b in the direction to the right hand

side of the window 22b.

The first time t_1 and the second time t_2 are displayed on the time axis TA. The fact that the second time t_2 is displayed in bold face shows that time t_2 has been
5 selected.

On the axis A 1, which is related to the first object OBJ 1, and on axis A 2, which is related to the second object OBJ 2, the first time bar TB 1, which is more or less rectangular in shape with the long side in the vertical direction in the drawing, is
10 displayed sitting astride axis A 1 and the axis A 2 at a position corresponding to the second time t_2 .

On the axis A 1 and the axis A 2, the first time bar TB 1' is displayed in broken lines sitting astride axis A 1 and the axis A 2, in a position corresponding to the first time t_1
15 1. The first time bar TB 1' is a hypothetical rendering of the status of the first time bar TB 1, which is being displayed at a position corresponding to the second time t_2 , as it would have been displayed at the position corresponding to the first time t_1 .

The first object OBJ 1 and the second object OBJ 2 in the first window 22a shown in
20 Fig. 4 are interlocked with the first time bar TB 1 in the second window 22 b. In other words, in the second window 22 b, when the first time bar TB 1 is caused to move from time bar TB 1' at a time t_1 to time bar TB 1 at a time t_2 , the first object OBJ 1 in the first window 22a moves along the first track TRJ 1 from the object OBJ 1' shown in dotted lines to the object OBJ 1 shown in solid lines. Moreover, the second object OBJ
25 2 in the first window 22a also moves in the same manner along the second track TRJ 2 from the second object OBJ 2' shown in broken lines to the second object OBJ 2 shown in solid lines.

A second time bar TB 2 can be added in the second window 22b, and editing can be
30 executed using two time bars. In the first window 22a, as shown in Fig. 6, are the first object OBJ 1, the first object displayed in bold face OBJ 1' and the first track TRJ 1,

which proceeds from the first object now displayed in bold face OBJ 1' toward the first object OBJ 1. Also appearing in the first window 22a are the second object OBJ 2, the second object now displayed in bold face OBJ 2' and the second track TRJ 2, which proceeds from the second object displayed in bold face OBJ 2' toward the second object OBJ 2. In the second window 22b, as shown in Fig. 7, the first time bar TB 1, is displayed sitting astride the axis A 1 and the axis A 2 in a position corresponding to the second time t 2, which is displayed in bold face on the time axis TA. In addition, in the second window 22b, the second time bar TB 2, which is also roughly rectangular in shape with the long side in the vertical direction in the drawing, is displayed in bold face sitting astride axis A 1 and axis A 2 in a position corresponding to the aforesaid first time t 1 on the time axis TA. The first time bar TB 1 in the second window 22b corresponds to the first object OBJ 1 and the second object OBJ 2 in the first window 22a. The second time bar TB 2 corresponds to the first object OBJ 1' displayed in bold face and the second object OBJ 2' likewise displayed in bold face in the first window 22a.

In the first window 22a, the first object OBJ 1', as shown in Fig. 8, moves from the first object OBJ 1' corresponding to the second time bar TB 2 at the first time t 1 in the second window 22b shown in Fig. 9, along the first track TRJ 1, through the first objects, OBJ 1c, OBJ 1b and OBJ 1a, which correspond to the direction of an elapse of time, up to the first object OBJ 1, which corresponds to the first time bar TB 1 at the second time t 2 in the aforesaid second window 22b.

Also in the first window 22a, the second object OBJ 2' moves from the second object OBJ 2' corresponding to the second time bar TB 2 at the first time t 1 in the second window 22b, along the second track TRJ 2, through the second objects, OBJ 2c, OBJ 2b and OBJ 2a, which correspond to an elapse of time, up to the second object OBJ 2, which corresponds to the first time bar TB 1 at the second time t 2 in the second window 22b.

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The movements of the first object OBJ 1 and of the second object OBJ 2 in the first

window result from the second time bar TB 2 being caused to move toward the second time t_2 in the direction of the elapse of time. While the second time bar TB 2 is being moved in the second window 22b from time t_1 to time t_2 , the position of the second object OBJ 2' in the first window 22a is being set by the operator. In this way, the position of the second object OBJ 2' can be set at the second time t_2 .

When a second time bar TB 2 is added in the second window 22b, it is possible to restrict the object displayed corresponding to this second time bar TB 2 to, for example, the second object OBJ 2. As shown in the second window 22b in Fig. 10, respectively displayed on the first time bar TB 1, which corresponding to time t_2 on the time axis TA, are points TB 1a, marked by "O", on axis A₁, which is related to the first object OBJ 1, and TB 1b, marked by "X", on axis A₂, which is related to the second object OBJ 2. Furthermore on the second time bar TB 2, which corresponds to time t_1 on the time axis, are TB 2a, marked with an "X" in a position corresponding to axis A₁ with regard to the first object OBJ 1, and TB 2b, marked with an "O", in a position corresponding to axis A₂ with regard to the second object OBJ 2. The mark "O" means that the corresponding object is displayed in the first window 22a, and similarly, the mark "X" means that the corresponding object is not displayed in the first window. Therefore, as shown in Fig. 11, the second object OBJ 2', which corresponds to TB 2b marked with "O" on the first time bar TB 1 is displayed in the first window 22a, while the first object OBJ 1, which corresponds to TB 2a marked "X" is not displayed. In addition, the first object OBJ 1, which corresponds to TB 1a marked with "O" on the first time bar TB 1, is displayed in the first window 22a, but the second object OBJ 2, which corresponds to TB 1b marked "X" is not displayed. Here the second object OBJ 2 corresponds to the second time bar TB 2.

In the second window 22b, when the second time bar TB 2 located at time t_1 is moved toward the aforesaid second time t_2 , which is in the direction of an elapse of time, the second object OBJ 2 moves in accompaniment with this second time bar TB 2 from the second object OBJ 2', in the direction of the second time t_2 along the second track TRJ 2, through the second object OBJ 2c, OBJ 2b and OBJ 2a, which correspond to

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respective times in the direction of movement of the second time bar TB 2, until the second time bar TB 2 reaches the second time t_2 and overlaps the first time bar TB 1, then the second object OBJ 2, which is shown in solid lines, is reached.

- 5 In this way, during an editing operation it is possible to selectively display only the required object, in the first window 22a thereby improving efficiency in editing operations.

A procedure executed by the central processing section 1 when the time bar is moved
10 is shown in Fig. 12. In the initial step S11, a time bar to be moved is selected, and the time corresponding to the time bar is set. For example, using the pointing device 13, the first time bar TB 1 or the second time bar TB 2 in the second window 22b can be selected. In the next step S12, with the movement of the selected time bar, the time corresponding to the time bar is acquired by the time bar control section 33 and
15 passed to the object control section. Next in step S13, the objects existing at the time specified on the time bar are acquired by the object control section 31 and transmitted to the object display control section 32. In the next step S14, the object display control section 32 acquires and displays the shape and other data of the objects whose display is necessary. The object control section 31 determines the objects whose
20 display will be required at the time of the time bar and passes a list thereof to the object display control section 32. Thereupon, the object display control section 32 acquires the data on display shape and the like for the respective objects and displays the objects in the first window 22a on the display screen of the CRT 22. Operation of the procedure then ends or returns to step S11 or step S12.

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A procedure executed by central processing section 1 when a time bar is added is shown in Fig. 13. In the initial step S21, time bar association is selected from the menu, using, for example, the pointing device 13 and operation proceeds to the next step S22. In step S22, the time at which the time bar is added is acquired by the time
30 bar control section 33, and this time is passed to the object control section 31. In the next step S23, the object control section 31 acquires the objects existing at the time

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of the added time bar and transmits them to the object display control section 32. In the following step S24, display data is acquired such as that on shapes and the like for the objects that it is necessary to display, and in the final step S25, the new time bar is displayed.

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By displaying at the same time and in the same shape the shapes of objects at multiple points of time or the changes of shapes between the various objects, it is possible, keeping the display of objects fixed at certain points of time, to simultaneously display objects at other points of time and to move those objects along
10 in time. In this way, editing the values of the positions of multiple objects at certain points of time can be carried out easily by the operator.

Moreover, it is possible to recognize the relationships between objects with reference to their shape and over time, not only the same objects, but other objects as well. Also,
15 by restricting the objects observed relative to each time bar, it is possible to display and check the movements of objects separately, so that it is possible to further improve the efficiency of editing operations.

Saving or application of the attributes of objects along the time axis based on key
20 frames is described below.

To save or apply the attributes of objects along a time axis, as shown in Fig. 14, the object control section 31, a key frame control section 34, which enables interval selection to control key frames, an attribute value control section 35, which controls
25 attribute values, and a saving data control section 36, which controls saving of data, are used. The object control section 31 is linked with the key frame control section 34, the attribute value control section 35 and the saving data control section 36, respectively.

30 When the second window 22b is involved in operations on the attributes of objects, as shown in Fig. 15, aside from the time axis TA, axis A 1, and axis A 2, selection buttons

including a "Time Bar" button B1, a "Start" button B2, an "End" button B3 and a "Save" button B4, are displayed above the time axis TA. In addition, a first key frame KF 1, a second key frame KF 2 and a third key frame KF 3 are displayed in order on the axis A 1, which is related to the first object OBJ 1, in the direction of elapsed time. Among
 5 these key frames, the first key frame KF 1 and the third key frame KF 3 are displayed in bold face.

When the "Time Bar" button B1 is selected, the first time bar TB 1' is displayed at the beginning of the time axis TA. When the "Start" button B2 is selected, as shown in Fig.
 10 16, the time bar TB 1' moves in the direction of elapsed time and overlaps the first key frame KF 1 to become the first time bar TB 1. When the "Time Bar " button B1 is selected with the first time bar TB 1 displayed, then as shown in Fig. 17, a second time bar TB 2' is displayed at the end of the time axis TA. When the "End" button B3 is selected, then as shown in Fig. 18, the second time bar TB 2', which is displayed at
 15 the end of the time line, moves in the reverse direction from that in which time elapses up to the position in which it is superimposed on the third key frame KF 3. In this way, an interval based on key frames or a key frame base for saving attributes is established.

20 In the second window 22b, when the "Save" button B4 is selected, a first menu window 40a as shown in Fig. 20 is displayed superimposed on the second window 22b shown in Fig. 19. In this first menu window 40a, displayed in descending order from the top of the window are a "Position" selection field 41, a "Direction" selection field 42, a "Size" selection field 43, a "Mode" selection field 44 and a "Confirmation" selection
 25 field 45. The selection fields 41 to 45, with the exception of the "Confirmation" selection field 45, have two states of "On" and "Off" and can be toggled between these two states using the pointing device 13. In the "On" state, a "return mark" is displayed. The "Confirmation" selection field 45 is used to confirm the settings of the aforesaid states, and when the "Confirmation selection field is selected, after the states have
 30 been set, the first menu window 40a is removed and the selections submitted.

In this first menu window 40a shown in Fig. 20 the "Position" selection field 21 and the "Direction" selection field 42 have been selected, and the return mark is displayed accordingly. The "Size" selection field 43 and the "Mode" selection field 44 have not been selected. In this case, the attribute values with regard to the position and direction, corresponding to the "Position" selection field 41 and the "Direction" selection field 42, are saved, and the attribute values with regard to the "Size" selection field 43 and the "Mode" selection field 44 are not saved. The "Mode" represents an operation state where the object can be selected for display at particular time points. For example, the mode may be set so that the object can be seen at t_1 and not t_2 .

After the attribute settings have been carried out in these selection fields, the "Confirmation" selection field selected, and the attribute values saved, a pool window 46 shown in Fig. 22 is displayed in the second window 22b shown in Fig. 21. The pool window 46 displays a first attribute data icon 47, a second attribute data icon 48 and a third attribute data icon 49. In this instance, the attribute data between the selected key frames has been saved in correspondence with the third attribute data icon which is displayed in bold face and represents the saved attribute data for subsequent application.

20

Application of the attributes, saved as explained above, is discussed below.

In the second window 22b, as shown in Fig. 23, the first key frame KF 1 and the second key frame KF 2 are displayed in the direction of the elapse time on axis A 2, which is related to the second object OBJ 2. There is no key frame displayed on axis A 1, which is related to the first object OBJ 1. When the "Time Bar" button B1 is selected, the first time bar TB 1' is displayed at the end of the time axis. When the "Start" button B2 is selected, as shown in Fig. 24, the first time bar TB 1' is moved to be superimposed on the first key frame KF 1 in the direction in which the time elapses, reaching the position of the first time bar TB 1. When the "Time Bar" button B1 is selected, as shown in Fig. 25, with the first time bar TB 1 in the display state, the

second time bar TB 2' is displayed at the end of the time axis TA. When the "End" button B3 is selected, as shown in Fig. 26, the second time bar TB 2' is moved to be superimposed on the second key frame KF 2 in the reverse direction to that of the elapsing of time to reach the second time bar TB 2. In this way, an interval is set
5 based on the key frames for applying attributes.

In the second window, as shown in Fig. 27, first the third attribute data icon 49 is selected from the pool window 46 and then dragged by the mouse to the interval between the first key frame KF 1 and the second key frame KF 2 on axis A 2, which
10 is related to the second object OBJ 2, and dropped in the interval. The third attribute data icon 49 is shown as attribute ATR on axis A 2, which is related to the second object OBJ 2.

When this attribute ATR is applied, a second menu window 40b shown in Fig. 28
15 appears in the second window 22b. The second menu window 40b is furnished with the same selection fields as the first menu window 40a shown in Fig. 20, being the "Position" selection field 41, the "Direction" selection field 42, the "Size" selection field 43, the "Mode" selection field 44 and the "Confirmation" field 45. Here, since the "Position" selection field 41 has been selected from among the selection fields 41 to
20 44, only the attribute data related to position is applied. When the "Confirmation" selection field 45 is selected, the application of the attribute field data is confirmed and applied to the interval into which the attribute ATR has been dropped.

When the attribute data of ATR is set in the second window 22b, as shown in Fig. 29,
25 a new key frame KF 1' is set up in the position newly established by the attribute data ATR on axis A 2, which is related to the second object OBJ 2.

As described above, in screen editing based on key frames, with attribute data pooled as an icon in the pool window 46, a new key frame is set up by dragging the attribute
30 data with the mouse and dropping it on the axis related to the desired object, whereby the attributes are set.

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A procedure for saving attribute data is shown in Fig. 30. In the initial step S31, a judgment is made on whether any of the buttons B1, B2, B3, or B4 has been pressed or not. If so the procedure proceeds depending on which is pressed. Specifically, in the event that the "Time Bar" button B1 has been pressed, the program proceeds to step S32, while if the "Start" button B2 or the "End" button B3 has been pressed, it proceeds to step S33, and if the "Save" button B4 has been pressed, it proceeds to step S34. In the event that none of the buttons B1 to B4 has been pressed, the program returns to step S31. In step S32, using the key frame control section 34, a new time bar is set up in the second window 22b in a position designated by the mouse, and the program returns to step S31. In step S33, using key frame control section 34, a time bar position is moved so that the time bar in question is superimposed on the closest key frame position in the second window 22b, and the program returns to step S31. In step S34, the start key frame and the end key frame that have been set are transmitted to the object control section 31, and the program proceeds to step S35. In step S35, the object control section 31 displays the attribute list menu as the first menu window 40a in Fig. 20. Attributes displayed on this attribute list menu can then be set and confirmed by selection of the "Confirmation" selection field 45 and the program proceeds to the following step S36. In step S36, the attributes set by the attribute list menu, the start key frame and the end key frame are transmitted to the attribute value control section 35. Next in step S37, the attribute value control section 35 collects the necessary data for the respective attributes for the saving control section 36, and brings the data together to save it on the disk 21. In the next and final step S38, the object control section 31 receives the notification of the completion of processing from the attribute value control section 35, adds attribute data newly saved on the save data pool which is displayed as pool window 46.

A procedure for applying the saved attribute data is shown in Fig. 31. In the initial step S41, a determination is made on whether any of the buttons B1, B2, or B3 has been pressed or not. If so the procedure proceeds depending on which is pressed. In the event that the "Time Bar" button B1 has been pressed, the program proceeds to step

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S42, while if the "Start" button B2 or the "End" button B3 has been pressed, it proceeds to step S43. In the event that none of the buttons B1 to B3 has been pressed, the program proceeds to step S44. In step S42, using the key frame control section 34, a new time bar is set up in the second window 22b in a position designated
5 by the mouse, and the program returns to step S41. In step S43, using key frame control section 34, a time bar position is moved so that the time bar in question is superimposed on the closest key frame position in the second window 22b, and the program returns to step S41.

10 In step S44, a determination is made as to whether the icon related to the data saved in the save data pool shown as pool window 46, has been dragged by the mouse or not. In the event that the icon has been dragged, the program proceeds to step S45, otherwise, for example, if it has not been dragged inside a designated interval, the program returns to step S41. In step S45, a determination is made as to whether or
15 not the icon related to the attribute data has been dropped by the mouse on the designated interval of a time axis related to an object inside the second window. In the event that the icon has been dropped on an axis related to an object the program proceeds to step S46, otherwise the program returns to step S41. In step S46, the start key frame and the end key frame that have been set up are transmitted to the object
20 control section 31. In the next step S47, the object control section 31 receives the saved data selected by the saved data pool screen displayed as pool window 46. Next in step S48, the object control section 31 displays the attribute list menu shown in the first menu window 40b in Fig. 28, and allows setting of the attributes displayed in this attribute list menu through the selection of the "Combination" selection filed. Next in
25 step S49, the object control section 31 transmits the attribute values designated, as well as the start and end key frames to the attribute value control section 35, and proceeds to the next step S50. In the final step S50, the attribute value control section 35 collects the data of the respective necessary attributes from the saved data, changes said data into a form that can be processed and generates a frame based
30 thereon.

The position of an object can thereby be taken as an illustration of an attribute, and use can be made with regard not only to the other attributes that change along a time axis such as direction, size, color, model type or shape, but also to fixed attributes without relation to time.

5

Visualization of an operation history of image editing using the image editing device is described below. The example described keeps changes in the direction of view of an object as a history of operations and displays the immediately preceding operation in a camera viewfinder when changing the direction of viewing an object on the screen
10 using 3-dimensional computer graphics model data. The control sections used include the object display control section 32, which controls the display of objects, a view operation control section 37, which controls and displays the direction of view of a camera viewfinder and a historical data control section 38, which controls a history of operations related to the object, as shown in Fig. 32.

15

A window 22c is displayed on the display screen of the CRT 22 for the operational history visualization. In the window 22c, as shown in Fig. 33, a more or less cube-shaped first object OBJ 1 is displayed, viewed diagonally from the upper right. Displayed with the first object OBJ 1 are the front surface in the center of the figure S1,
20 the right surface S2 to the right of the front surface S1 and the top surface S3 above the front surface S1, respectively. A view operation control panel 50 as shown in Fig. 34 is displayed as another window 22d on the display screen of the CRT 22. The panel 50 has a viewfinder 51 and a view input section 52. The panel 50 shows the direction of viewing the first object OBJ 1 displayed in window 22c as the direction of
25 a die 53. The first surface S 1 on which the "•" of the front surface of the die 53 is displayed corresponds to the direction of viewing the front surface S 1 of the object in Fig. 33. In the view input section 52 of the view operation panel 50, a select button 52a indicates the rightward direction can be selected. When this is done, in the other window 22c, the direction from which the first object OBJ 1 was seen changes, and as
30 shown in Fig. 35, the right side of the first object OBJ 1 becomes the front in the figure, and the back side S 4 to the right of this right surface S 2 and the top surface S 3

above the aforesaid right surface S 2 are displayed. At this time, with the die 53 in the viewfinder, as shown in Fig. 36, the first surface on which “•” is displayed faces the left. This means, as shown in Fig. 37, that the first direction D 1 vis-à-vis the front surface had been taken as the view direction, but the second direction D 2 has become the
5 view direction.

A procedure related to the window 22c and the control panel 50 is shown in Fig. 38. In the initial step S51, a determination is made as to whether a button is selected using the view operation input section 52 of the view operation control panel 50. In the event
10 of input into the view operation input section 52, the program proceeds to step S52, while in the event that a view operation button has not been pressed, it returns to step S51. In step S52, the button which has been selected is transmitted to the historical data control section 38, and the corresponding visual image data information is obtained and displayed. For the historical operation control section 38, the program
15 proceeds to step S61, described below and returns via step 63 and then the program proceeds to the next step S53. In step S53, the view direction from which the object is now seen is transmitted to the object display control section 32. In the next and final step S54, the object display control section reprocesses and displays the shape and so forth of the object based on the view direction received.

20

In step S61, as shown in Fig. 39, information is received regarding which button of the view operation input section of the view operation control panel 50 has been selected. In the next step S62, based on the operation corresponding to the input the historical data control section will access visual data corresponding thereto, return that
25 information to the visual operation control section 37 and proceed to step S63. In step S63, the operation data is updated as the most recent on a historical data list.

A described above, processing related to the view is saved as historical data by the historical data control section 38. At this time the visual data corresponding to each
30 operation by the view operation control panel 50 is returned to the view panel 50 and at the same time the coding of that operation is stored as operational history. The

coded operation data is retrieved from the historical data section 38 for a particular time series.

Setting and changing a hierarchy in each key frame in terms of the editing of objects along the time axis is described below. In the image editing device, when carrying out settings or changes in a hierarchical structure, the object display control section 32 controls the display of objects, the object control section 31 controls objects, and the attribute value control section 35, controls attribute values, with a relationship, as shown in Fig. 40, where the object control section 31 is connected respectively to object display control section 32 and the attribute value control section 35. An example occurs in the grouping of at least two objects and, keeping them at a fixed distance, whilst moving them in accompaniment with a parent object when editing along the time axis based on key frames using 3-dimensional computer graphics model data.

In a window 22e, as shown in Fig. 41, a first object OBJ 1, which is a roughly equilateral triangle, and a second object OBJ 2 are displayed. A hierarchical structure between objects is introduced between the first object OBJ 1 and the second object OBJ 2 as a group by first selecting the second object OBJ 2 by clicking the mouse on the second object OBJ 2. When the second object OBJ 2 is dragged with the cursor 55, as shown in Fig. 42, a semi-transparent second object OBJ 2' comes into being, and with this semi-transparent second object OBJ 2' superimposed on the first object OBJ 1, as shown in Fig. 43, this second object OBJ 2' is dropped. When this is done, a hierarchical parent-subordinate relationship is set up with the first object OBJ 1 onto which the drop was made as the parent object, and the second object OBJ 2, which was dropped as the subordinate object. Here, the parent object refers to the object of higher rank and the subordinate object refers to the object of lower rank. In setting of the hierarchical structure, in addition to the dragging method described, it is also possible to select the targeted object from a displayed list or menu and making the selection from the list or menu.

30

The subordinate object can be made to follow the parent object, as shown in Fig. 44,

and the attributes related to the direction of the parent object can be applied. In other words, the direction of the subordinate object follows the parent object, and if, for example, the subordinate object is made as model data in the form of a human being, the surface that corresponds to the face of the human being can be kept pointed in the direction of the parent object. The first object OBJ 1, which is the parent object located close to the left edge of Fig. 44 can be passed through the first object OBJ 1' roughly in the upper central position in the window 22c, and when it moves to the first object OBJ 1'', which is close to the right edge, the triangle 56, which is part of the subordinate second object OBJ 2, follows the direction of the aforesaid first object OBJ 1 to OBJ 1'', according to the hierarchical relationship which has been set up for the attribute of direction. The above changes for key frames can be carried out for each key frame or sub-key frame.

In the past the traditional setting up of the hierarchical structure, in cases where object grouping is carried out between, for example, the triangular first object OBJ 1 and a pentagonal second object OBJ 2, as shown in the window in Fig. 45, involved designating a range for a rectangular field in which the grouping is done, as shown in Fig. 46.

A procedure for handling the set up and processing of parent objects is shown in Fig. 47. In the initial step S71, a pause is made to allow detection of a mouse, and in the next step S72, determination is made as to whether or not a target object has been selected by the cursor 55. In the event that a target object that has been designated by the cursor 55, operation proceeds to step S73, otherwise operation returns to step S71. In step S73, the object control section 31 determines which object has been selected and the selected object is made semi-transparent. Next in step S74, a determination is made whether or not the selected object is being dragged. In the event that it is being dragged, the program proceeds to step S75, otherwise it proceeds to step S76. In step S75, in the window 22e, with the object being kept semi-transparent, the cursor position is displayed and the program returns to step S74.

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In step S76, determination is made as to whether or not the position onto which the selected object that is dropped corresponds to another object. In the event that the position onto which the drop was made corresponds to the other object, the program proceeds to step S77, otherwise the procedure ends. In the final step S77, the semi-transparent display of the object being dragged is terminated, and information concerning the other object on which the object has been dropped is relayed to the object control section 31.

A procedure related to data processing between grouped objects is shown in Fig. 48.

10 In the initial step S81, the objects are divided according to whether they are at rest or in motion. For those at rest, processing proceeds to step S82, and for those in motion, processing proceeds to step S85.

In step S82, the object control section 31 acquires the parent object from the object display control section 32 and at step S83, and the object control section 31 directs the parent object data to the attribute value control section 35. Next in step S84, the attribute value control section 35 acquires the position of the object, to maintain the distance and direction from the subordinate object.

20 In step S85, the attribute value control section 35 acquires the current time, and in the next step S86 it acquires the position of the parent object at the time acquired in step S85. Next in step S87, the position of the subordinate object is calculated from the distance and direction being maintained from and based on the position of the parent object.

25

The image editing device can also group tracks set up between two key frames and group multiple tracks in the course of editing objects using the time axis and key frames.

30 When grouping tracks the object display control section 32, as shown in Fig. 49, controls the display of objects, the key frame control section 34, controls key frames,

and a track control section 39, controls tracks, and the key frame control section 34, is respectively linked to object display control section 32 and the track control section 39.

5 A window 22f, as shown in Fig. 50, on the display screen of the CRT 22 displays tracks on which the objects are depicted. A first track TRJ 1 of a first object OBJ 1 changes its position to move from a first key frame KF 1 to a second key frame KF 2, displayed as squares at each end of the track TRJ 1. On the first track TRJ 1, a first sub-key frame SKF 1, a second sub-key frame SKF 2, a third sub-key frame SKF 3,
 10 a fourth sub-key frame SKF 4 and a fifth sub-key frame SKF 5 are displayed in sequence from the first key frame KF 1 toward the second key frame KF 2. Except for the first sub-key frame SKF 1, which overlaps the first key frame KF 1 and the fifth sub-key frame SKF 5, which overlaps the second key frame KF 2, the sub-key frames are displayed as circles. And, in Fig. 50, a roughly equilateral triangular first object
 15 OBJ 1 is displayed overlapping the third sub-key frame SKF 3.

The first track TRJ 1 can be changed by movement of the sub-key frames SKF 1 to SKF 5 through which the first track TRJ 1 passes. For example, first track TRJ 1', shown in Fig. 51, is identical with the first track TRJ 1 shown in Fig. 50, but by moving
 20 the second sub-key frame SKF 2', the third sub-key frame SKF 3' and the fourth sub-key frame SKF 4' on this first track TRJ 1' and positioning them to correspond to the second sub-key frame SKF 2, the third sub-key frame SKF 3 and the fourth sub-key frame SKF 4 respectively, the first track TRJ 1' can be changed into the first track TRJ 1 that passes through these sub-key frames from SKF 1 up to SKF 5. The first sub-key
 25 frame SKF 1, which overlaps the first key frame KF 1, and the fifth sub-key frame SKF 5, which overlaps the second key frame KF 2, do not move and are maintained in their original positions.

Furthermore, the track TRJ 1' with the sub-key frames SKF 1 to SKF 5 can be moved,
 30 as shown in Fig. 52, to produce a new track TRJ 1 with the shape of the track TRJ 1' being maintained by, for example, selecting the second key frame KF 2' with the

mouse, dragging it to a desired position and dropping it in the position for the second key frame KF 2 as shown.

A procedure related to the process of changing a track using key frames and sub-key frames is shown in Fig. 53. In the initial step S91, the object display control section 32 passes data on which key or sub-key frame has been selected and on the position to which it has been moved to the key frame control section 34. In the next step S92, the key frame control section 34 passes data on the original position of each key frame and data on the new positions to the track control section 39. In the event of a change in the key frame, the program proceeds to step S93, while in the event of a change in a sub-key frame, it proceeds to step S94. In step S93, the track control section 39 generates data on the positions of the track and the key frames relative to the key frames. The data for each position relative to sub-key frames is maintained and new positional data are generated from the extent of change in the position data of the key frames. The position data generated is returned to the key frame control section 34, and the program proceeds to step S95. In step S95, the key frame control section 34 accesses the position data for each point of time on the track from the key frame KF 1 to key frame KF 5, returns the data to the object display control section 32. In the final step S96, the object display control section 32 carries out rendering of the object and the shape of its track, and displays the result on the screen.

Here, for the purpose of reference, a description will be given regarding traditional changes in tracks. This track, as shown in Fig. 54, is the track through which the first object OBJ 1 has passed on the window, taking the first time KF 1 as the starting point, passing through the second key frame KF 2, the third key frame KF 3 and the fourth key frame KF 4, with the fifth key frame KF 5 taken as the end point. In the drawing, there is the aforesaid first object OBJ 1, and that first object OBJ 1 is displayed when it is located on the third key frame KF 3. An operator then has to change the data of each Key Frame KF 1, ..., KF 5 in memory, by changing each visual object.

30

The image editing device makes it become possible to display the shapes of an object

at multiple points of time or the variations of shape between objects in the same space at the same time. Because of this, it is possible to keep an object fixed and displayed at a certain point of time, and at the same time to display an object at another point of time, and moving the objects in time. This provides a considerable improvement over
5 traditional methods when editing the values of such things as the positions of multiple objects at a certain point of time. Furthermore, the relationships between the objects can be recognized not only with the same objects, but also across time with shapes that include other objects. It is also possible to restrict the objects observed each time to each time bar and display the movement of each object separately, further
10 improving editing efficiency.

In addition, in terms of the editing of objects based on key frames, it is possible to select two desired points and save or apply the data of one or more of the attributes possessed by the object in that interval. Moreover, it is possible when saving to select
15 only the necessary items from among the attributes possessed by the object, or when applying, to apply only the attributes that the object possess or select from among them. Accordingly it is possible to save the movement of preferred intervals of objects in which multiple attributes have been combined, such as, for example, position and direction, the original generation of which would have required considerable effort. It
20 is also now possible to employ favored movements or changes in different settings by selectively choosing and applying data on multiple attribute values from the save data between two desired points of another object or the same object. In this way, it is possible to make the reuse of animation in authoring easier, as well as to dramatically increase the efficiency of the authoring process.

25

Furthermore, carrying out editing or browsing operations while keeping a history of operations, it is possible to become aware at a glance of what the operations were carried out previously by visualizing in an easily understandable manner what each operation is. In the event that a return is made to the original operation, it will suffice
30 merely to look at the history to see how far back it is necessary to go, without having to repeat operations haphazardly. Also, during the running of the immediately

preceding operation, it is possible to determine which operation is to be carried out from this point or to return to the original operation by setting a permanent display.

In terms editing of objects based on key frames, it is possible to maintain the relationships between objects as hierarchical structures, and to change those structures. As a result, it is possible to perform animation of grouped objects by grouping together objects and bringing about changes to the objects as a group.

Furthermore, with the image editing device it is possible to make changes easily in the values of the key frames at both ends while maintaining the relative positions in the tracks set between key frames. Also, operations involving the addition and deletion of key frames have been reduced because grouping is possible through the introduction of sub-key frames, and track adjustment operations can be executed based on sub-key frames, without requiring attention to the setting of values of neighboring key frames.

15

Many modifications will be apparent to those skilled in the art without departing from the scope of the present invention as hereinbefore described with reference to the drawings.

CLAIMS

- 5 1. An image editing device for editing images including objects related to a time axis, said device comprising:
- means for displaying on the same screen a time axis display field showing a plurality of time bars which indicate times on the time axis and an object display field showing plurality of objects;
- 10 means for adjusting the relative location of the time bars on the time axis;
- control means for correlating the objects displayed in the object display field with the times indicated by the time bars; and
- a history control section for controlling historical information related to the history of a series of operations and for placing the said historical information into visual form for
- 15 display by said display means.
2. Editing device as claimed in claim 1, wherein the control means is adapted to switch between a display status and no display status for each object corresponding to
- 20 each time bar, and cause display of said status on the respective time bar.
3. An image editing device as claimed in claim 1, wherein said objects represent 3-dimensional figures or 2-dimensional figures.
- 25 4. An image editing device as claimed in claim 1, wherein said objects represent characters or still or moving images.
5. An image editing device as claimed in claim 1, wherein said display means distinguishes selected objects.
- 30 6. An image editing device as claimed in claim 1, wherein said history control section causes display of said history with respect to the direction of the object as a perspective view of a 3-dimensional object.
- 35

7. An image editing device as claimed in claim 1, including a hierarchical structure control means for controlling changes in a hierarchical relationship structure between objects.

8. An image editing device as claimed in claim 7, wherein said hierarchical structure is a tree structure where at least one object of a lower rank corresponds to an object of a higher rank in the hierarchy.

9. An image editing device as claimed in claim 7, wherein said hierarchical structure control means causes said display means to superimpose one object onto another object based on said hierarchical structure.

10. An image editing device as claimed in claim 7, wherein when said object is defined as a key frame at a discrete time on a time axis line, the hierarchical structure control means adjusts the hierarchical structure on the basis of said key frame.

11. An image editing device as claimed in claim 1, wherein a track of an object can be set between key frames at discrete times, and said device includes key frame control means for controlling temporal or positional data corresponding to the key frames, and track control means for determining a track from said data corresponding to said key frame.

12. An image editing device as claimed in claim 11, wherein said key frame control means groups the tracks of single/multiple objects.

13. An image editing device as claimed in claim 11, wherein said track comprises attribute data, including at least one of position, direction, size and angle data, and represents continuous change along the time axis of the object.

14. An image editing method for editing images including objects associated with a time axis, said method including the steps of:

displaying on the same screen a time axis display field showing a plurality of time bars which indicate times on a time axis and an object display field showing a plurality of objects;

adjusting the time bars relative to the time axis to select said times;

correlating the objects displayed in the object display field with times indicated by the time bars;

controlling historical information related to the history of a series of operations;

and

placing the said historical information in its visual form for display.

15. An image editing device for editing images associated with a time axis and including objects having attribute data comprising at least one of position, direction, size or angle data, said device comprising:

display means for displaying on the same screen a time axis display field showing a plurality of time bars which indicate times on the time axis and an object display field showing a plurality of objects;

means for adjusting the relative location of the time bars to select said times;

control means correlating the objects displayed in the object display field with the times indicated by the time bars;

interval means for selecting intervals along the time axis of said objects;

attribute means for controlling attribute values of the intervals selected by said interval means; and

means for saving time and attribute data of said objects.

16. An image editing device as claimed in claim 15, wherein categories of attributes of said objects can be selected, applied to objects and saved.

17. An image editing device as claimed in claim 16, wherein when an attribute of one interval of said object has been saved, and the attribute of said one interval is applied to said object or to the attribute of another interval of another object, the attribute of a category that overlaps the gap between the attribute of the said one interval and the attribute of the aforesaid other interval is applied.

5 18. An image editing device as claimed in claim 15, wherein said object represents a 3-dimensional figure, 2-dimensional figure. A character, a still image or an animated image.

19. An image editing method for editing images associated with a time axis and including objects having attribute data comprising at least one of position, direction, size or angle data, said method including the steps of:

displaying on the same screen a time axis display field showing a plurality of time bars which indicate times on time axis and an object display field showing a plurality of objects;

15 adjusting the time bars relative to the time axis set said times;

correlating the objects displayed in the object display field with the times indicated by the time bars;

selecting intervals along the time axis of said objects;

controlling attribute values of the intervals selected by said interval means; and

20 saving time and attribute data of said objects.