DESCRIPTION

VIDEO INFORMATION REPRODUCTION DEVICE AND REPRODUCTION METHOD

Technical Field

[0001]

The present invention relates to a video information reproduction device which, via a network, receives signals including video information data (hereinafter, may be referred to as only "video data") and reproduces the video, and especially relates to frame control of video signals for displaying the video data on multiple displays.

Background Art

[0002]

It is conventional that, when instructed to reproduce video in a reproduction device, firstly DEMUX processing to separate (decode) communication-channel-encoded signals having been multiplexed and transmitted is executed, and then processing to decode the information-source-encoded signals is started. The encoded video data contained in the information-source-encoded signals is decoded for reproduction by a decoder and displayed on an image display device.

[0003]

In order to synchronize video reproduction, the decoder reads display time information of video frames included in control data of the received signals, and then the frames are switched to be displayed on the basis of the time information read out. The video reproduction synchronization method is performed on the basis of an internal time measured by a hardware clock installed in the video information reproduction device.

[0004]

Generally, the internal time varies depending on an oscillation frequency error (several to a hundred ppm) of the crystal oscillator driving the hardware clock, as well as on load increase in the receiving terminal and other factors such as temperature, humidity and voltage. If the oscillation frequency error of the crystal oscillator is about 20 ppm, this results in a difference of about three seconds per day.

[0005]

If multiple video information reproduction devices with such hardware clocks are connected to a network to receive video data distributed from a video content server, the clock discrepancies among the content server and the video information reproduction devices may cause problems in that it is impossible, for example, to properly exchange data among the devices. Therefore, the devices are synchronized with each other through NTP (Network Time Protocol: hereinafter, may be referred to as only NTP) which synchronizes the clocks provided in the respective devices to a correct time (hereinafter, may be referred to as reference time).

[0006]

The clocks of the respective devices can be adjusted through NTP to achieve clock synchronization. However, for example during reproduction of a video, a sudden time change may cause problems such as discontinuous reproduction or premature termination.

[0007]

To cope with the problems, methods are proposed to detect the relative time difference between the reference time and the time information of the video information reproduction device, and to synchronize and reproduce video on the basis of the difference. Among them, for example, there is an adjustment method in which I or P pictures displaying the same content as the last frame of the main part of the coded video data read from the storage media, are added after the last frame of the main part as frames for reproduction synchronization, and the number of the frames for reproduction synchronization is varied in accordance with the reference time information (for example, refer to Patent Document 1).

[0008]

As a method for correcting the hardware clock of the video information reproduction device to the reference time, there is a method to adjust the internal time so as to gradually come closer to the reference time, by using a scaler which divides a first clock for correction of the hardware clock to generate and output a second clock, and by using a timer to generate internal time information on the basis of the second clock, to adjust the division ratio of the scaler at every clock time period of the second clock on the basis of the difference between the internal time and the reference time as well as the predetermined length of time to be spent for the time correction (for example, refer to Patent Document 2).

Prior Art Document

Patent Document

[0009]

Patent Document 1

Japanese Patent Laid-Open Publication No. 2011-114681

Patent Document 2

Japanese Patent Laid-Open Publication No. 2010-107342

Summary of the Invention

Problems to be solved by the Invention

[0010]

According to the adjustment method relating to Patent Document 1, however, the video data is firstly processed on a content server, and then distributed to multiple video information reproduction devices, which results in a problem that the processing load of the content server is increased. As is the case with digital signage businesses, in a case where video data is supplied from a customer in advance to display the video, it is also a problem to process the customer-owned data.

[0011]

The adjustment method according to Patent Document 2 can smoothly adjust the hardware clock, while having a problem that it takes a longer time for correction thereof.

Means to solve the Problems

[0012]

A video information reproduction device according to the present invention includes a time information detector to receive a signal including video data and control data thereof via a network and to acquire time information included in the control data, an internal time detector to detect internal time measured by an internal clock, a comparison unit to compare time given by the time information acquired by the time information detector and the internal time measured by the internal time detector, and a frame controller to control, on the basis of the comparison result of the comparison unit, the number of frames to be displayed based on the number of frames per unit time of the video data and the number of frames to be displayed corresponding to a single frame of the video data.

Effects of the Invention

[0013]

According to the present invention, when a time difference is detected between the time of hardware clock of a video information reproduction device and the reference time of a content server, the time difference is reduced by increasing or decreasing the number of frames displayed, in other words, by varying the display time per frame of the video data included in the received signals.

[0014]

Also, because the content server does not need to process the video data and can distribute the stored original video data as it is, the processing load of the content sever can be reduced.

Brief explanation of Drawings

[0015]

Fig. 1 is a diagram showing a conceptual configuration of an entire video information reproduction system according to Embodiment 1 of the present invention.

Fig. 2 is a block diagram schematically showing an example configuration of the video information reproduction device according to Embodiment 1 of the present invention.

Fig. 3 is a diagram illustrating a frame display method when there is no difference between a reference time and an internal time of a video information reproduction device.

Fig. 4 is a diagram illustrating the frame display method when the internal time of the video information reproduction device is behind the reference time.

Fig. 5 is a diagram illustrating a frame display method when the internal time of the video information reproduction device is ahead of the reference time.

Fig. 6 is a flowchart showing how the video information reproduction device reproduces video information.

Fig. 7 is a flowchart showing how a content server distributes video information.

Fig. 8 is a diagram showing a conceptual configuration of an entire video information reproduction system according to Embodiment 2 of the present invention.

Fig. 9 is a block diagram showing a video information reproduction device according to Embodiment 2 of the present invention.

Embodiments to carry out the Invention

[0016]

Embodiment 1

Next, embodiments of the present invention will be explained using drawings. In the drawings shown below, the same or similar symbols correspond to the same or similar components. Note, however, that the drawings are schematically illustrated, and the respective size ratios and so the like differ from the actual ones. Therefore, the actual sizes and the like must be determined considering the explanations below. Not to mention that the drawings may include portions whose size relations or ratios differ therebetween.

[0017]

Fig. 1 is a block diagram schematically illustrating a video information reproduction system including video information reproduction devices and a content server to distribute signals including video data. Their explanation will be made below with drawings. In the figure, a content server 50 is a server to distribute digital data including video data and control data thereof to multiple video information reproduction devices. The content server 50 distributes, via for example a network 51 configured as LAN (Local Area Network: hereinafter, may be referred to as only LAN), the data to video information reproduction devices 30, which in this case are a first video information reproduction device 31, a second video information reproduction device 32, a third video information reproduction device 33 and a forth video information reproduction device 34. The first video information reproduction device 31, the second video information reproduction device 32, the third video information reproduction device 33 and the forth video information reproduction device 34 have a same configuration, and each of them receives signals including video data distributed from the content server 50.

[0018]

The digital data to be distributed from the content server 50 to the video information reproduction devices 30 includes, for example, video data, voice data and their control data, as well as server clock information data, and data for checking the communicability of the video information reproduction devices. In the following explanation, it is supposed that digital data is distributed by broadcasting the digital data on the network 51 using UDP (User Datagram Protocol: hereinafter, may be referred to as only UDP). Here, the transmission signals are supposed to be signals configured with digital data. However, the data to be transmitted is not limited to

digital data. Analog data may be transmitted by utilizing amplitude-modulation or frequency-modulation.

[0019]

Fig. 2 is a block diagram showing a video information reproduction device, which in this case is the first video information reproduction device, according to Embodiment 1 of the present invention. In addition, other video information reproduction devices have the same configuration. Using the figure, the video information reproduction devices 30 will be explained, taking an example of the first video information reproduction device 31; and the explanation is applicable to other video information reproduction devices. The first video information reproduction device 31 includes a video reproduction processing unit 23 and a display unit 22; the video reproduction processing unit 23 has a function to decode the video data distributed from the content server 50, and a function to determine (when detecting that a delay or advance of the time measured by an internal clock of the video information reproduction device 30 occurs with respect to the content server 50, and storing the time information of the delay or advance) a type of frame processing to be performed among types of frame processing such as to shorten the display time per frame included in the distributed video data by increasing the number of frames to be displayed per unit time by the display unit 22 (hereinafter, may be referred to as only display), and to increase the number of frames of the same image; and the display 22 displays the video on the basis of the frame processing determined by the video reproduction processing unit 23.

[0020]

By such frame rate conversion or the like, the display 22 is capable of receiving and displaying video signals at a frame rate higher than the frame rate contained in the distributed video data. For example, in a case where the video data containing a frame rate of 30 fps (Frames Per Second: hereinafter, may be referred to as only fps) is reproduced, it is assumed that the display 22 is capable of displaying video data at a frame rate higher than 30 fps. For example, in a case where a display capable of displaying video data at 60 fps is used as the display 22, the actual per-frame display time after converting frame rate to the double of the number of frames per unit time is shorter than approximately 33.3 ms (1/30 s, hereinafter the word “approximately” may be omitted) which is the per-frame display time of the original video data before the frame rate conversion. In a case where a delay occurs in reproducing, the use of this type of display can eliminate the reproduction delay by making the actual display time shorter than 33.3 ms, the per-frame display time of the original video data.

[0021]

In the above embodiment, it is supposed that through frame rate conversion or the like, the display 22 is capable of receiving and displaying video signals at a frame rate higher than a frame rate contained in the distributed video data. However, in a case where an advance occurs in reproducing video, if the display is capable of

receiving and displaying video signals at only the same frame rate as that contained in the distributed video data, the reproduction advance can be corrected by performing operations such as successively displaying a same frame to make the display time longer than 33.3 ms which is the supposed per-frame display time of the original video data.

[0022]

The video reproduction processing unit 23 includes a data receiver 10, a reference time detection unit 11, a data storage 13, a reproduction controller 14, an output-time controller 19, and an output-time measuring unit 20, all of which are connected via a bus 21.

[0023]

The data receiver 10 receives encoded video data such as MPEG-2, H.264 or H.265 from the content server 50 connected with the video information reproduction devices 30 via LAN.

[0024]

Because the content server 50 connected to the LAN periodically transmits time information according to NTP, the reference time detection unit 11 detects the time information of the content server 50. Here, the time which is indicated by the content server 50 and is to be detected by the reference time detection unit 11 is used as reference time. Here, the time information to be detected may be, for example, time information received in relation to absolute time indicated by the content server 50, or information in relation to a frame which the content server 50 currently intends to display.

[0025]

The data storage 13 includes a buffer memory such as RAM to temporarily store video data received by the video information reproduction device according to Embodiment 1 of the present invention, ROM to store an operation program of the video information reproduction device according to Embodiment 1 of the present invention, and other components.

[0026]

A frame controller includes the reproduction controller 14 and the output time controller 19.

[0027]

The reproduction controller 14 is a part of the frame controller to perform reproduction control of frames. The reproduction controller 14 decodes the encoded video data, and compares the reference time information of the content server 50 with time information of the internal clock of the video information reproduction device 30; when detecting a delay or advance in reproduction timing, the reproduction controller controls the number of frames to be displayed and the display time of a frame in accordance with the amount of the delay or advance.

[0028]

The output time controller 19 controls the per-frame display time, as a part of the frame controller performing the reproduction control of the frames. The output time controller 19, asynchronously with the reproduction display times of the respective frames included in the video data for being reproduced, shortens or lengthens the display time of the frames to be displayed in accordance with the control of the number of frames performed by the reproduction controller 14.

[0029]

The output-time measuring unit 20 includes a hardware clock and other components, that is to say, the output-time measuring unit has a means to measure time when shortening or lengthening the display time of frames in accordance with the control of the reproduction controller 14.

[0030]

The reproduction controller 14 includes a video decoder 15, a comparison unit 16, a storage 17 and an output update unit 18.

[0031]

The video decoder 15 decodes the video data received by the data receiver 10, which has been compression-encoded as MPEG-2, MPEG-4, H.264 or H.265.

[0032]

The comparison unit 16 compares the time information of the content server 50 received by the reference time detection unit 11 with the reference time information for display control of the video information reproduction device 30, and detects delay or advance in the video reproduction timing with respect to the content server 50.

[0033]

The storage 17 stores the time of delay or advance detected by the comparison unit 16 in video reproduction timing of the video information reproduction device 30.

[0034]

The output update unit 18 has a feature to vary the frame output time to an integral multiple of the per-frame display time for which the display is capable of displaying a single frame. This means that, for example, in a case where a display capable of displaying video data at 60 fps is used for displaying 30-fps video data, the per-frame display time is varied to 16.7 ms (1/60 s), 33.3 ms (2/60 s), 50.0 ms (3/60 s), 66.7 ms (4/60 ms), and so on. The frame display time is determined, on the basis of a display timing delay or advance of the video information reproduction device 30 stored in the storage 17, so as to prevent a frame drop by assigning nonzero to every frame output time.

[0035]

On the basis of the time information of the hardware clock, a conventional video reproduction device synchronously reproduces video according to decode times and display start times of respective frames included in the video data. Therefore, when video data of 30 fps is to be reproduced, frames are switched every 33.3 ms because frames are started to display at intervals of 33.3 ms (1/30 s). However,

because the hardware clock is self-propelled to measure time, this results in a time difference from the reference time of the content server or any one of other video information reproduction devices installed together.

[0036]

To cope with this, the video information reproduction device according to Embodiment 1 of the present invention does not refer to the display start time information included in the received data, and uses a display which is capable of reproducing video from the received video data at a frame rate higher than that of the received video data , so that the frame display time can be varied to reduce the time difference from the time of the content server 50, which is the reference time information. In a case of displaying a still image including same images, even if a display capable of displaying at the same frame rate as that of the received video data is used, the content's switching timing can be adjusted so as to make the hardware clock agree with the reference time by adding or eliminating frames. A further effect is obtained that even a moving picture having different information frame by frame can be smoothly reproduced in a manner free from feeling strangeness caused by a frame drop.

[0037]

Fig. 3 is a schematic view showing the relation between a frame configuration and reproduction frames of video data in a case where there is no time difference between the content server and the video information reproduction device. In the figure, the frame rate of the video data is 30 fps, and the display is capable of displaying at 60 fps. The frame rate of the video data is 30 fps to switch frames at every 33.3 ms. On the other hand, with a capability of 60 fps, the display can switch frames at about every 16.7 ms (1/60 s, hereinafter the word "about" may be omitted). Therefore, in the display vertically synchronizing at 16.7 ms (1/60 s), an image transmitted as one frame is displayed as two frames containing the same image information.

[0038]

Fig. 4 is a diagram showing a method for the video information reproduction device to process when detecting that the frame display timing of the video information reproduction device is, for example, 33.3 ms behind the reference time of the content server. In the figure, when reception data of 30 fps is reproduced, every single frame is originally to be switched at 33.3 ms. For example, if the display is capable of displaying at 60 fps, an image transmitted as a single frame is to be displayed as two frames containing the same image information. In this case, in order to reduce the time difference between the reference time and the internal time given by the hardware clock, a certain image information is displayed as one frame instead of original two frames, to cut 16.7 ms (1/60 s) corresponding to one frame, reducing the time delay by that amount. If this is performed for certain two images, 33.3 ms corresponding to two frames can be cut, eliminating the time delay. In this case, there occurs no frame drop in which certain image information is not displayed at all,

and all the frames are to be displayed. A frame display timing delay of the video information reproduction device 30 against the reference time of the content server 50 can be corrected without causing a feeling of strangeness by controlling the display-time reduction amount below the human visual resolution in the time axis direction.

[0039]

In the case of Fig. 4, the display times of predetermined multiple frames are reduced to their halves to avoid a frame drop. Note, however, that a frame drop is acceptable in such a case where still images of the same content are displayed for multiple frames for a certain time period, and then switched. In such a case, simple processing of not displaying predetermined frames is acceptable, instead of the complicate processing of reducing the display times to their halves.

[0040]

Fig. 5 is a diagram showing a frame display method when it is detected that the frame display timing of the video information reproduction device is, for example, 33.3 ms ahead of the reference time of the content server. In the figure, when the received data of 30 fps is reproduced, every single frame is originally to be switched at 33.3 ms. For example, if the display is capable of displaying at 60 fps, an image transmitted as one frame is to be displayed as two frames including the same image information. In this case, in order to reduce the time difference between the reference time and the internal time given by the hardware clock, predetermined image information is displayed as three frames, instead of displaying the two frames, to cut 16.7 ms (1/60 s) corresponding to one frame, reducing the time advance by that amount. If this method is performed for predetermined two images, 33.3 ms corresponding to two frames can be cut, and the time advance can be eliminated. Here, this method was performed for the predetermined two images. Instead, a predetermined single image is also displayed as 4 frames, to eliminate the time advance. In a case of much advance, it goes without saying that the number of predetermined images can be 4 or more, or 4 or more frames can be displayed for a predetermined single image.

[0041]

Next, explanation will be made about a sequence in which the video data distributed by the content server is finally reproduced by the video information reproduction device. Upon a user's request to the content server 50 for data transmission in order to start reproduction, the content server 50 starts transmitting video data and other data by broadcasting them to the fist video information reproduction device 31, the second video information reproduction device 32, and the third video information reproduction device 33 and the fourth video information reproduction device 34. The request for starting the reproduction may be performed by, for example, transmission of a signal from any one of the video information reproduction devices.

[0042]

Fig. 6 is a flowchart showing a processing sequence of each video information reproduction device for synchronized reproduction among the multiple video information reproduction devices. In the figure, at step ST1, when the receiver 10 receives video data in a format such as MPEG-2, H.264 or H.265 from the content server 50, the video decoder 15 in the data reproduction controller 14 starts decoding the video data.

[0043]

Next, when time information used as a reference is received by the reference time detection unit 11 at step ST2, the process proceeds to step ST3. The time information is transmitted from the content server 50, for example, at every 10 seconds. The time information of the content server 50 received at this step may be, for example, received time information relating to the absolute time indicated by the content server 50 or may indicate information relating to a frame which the content server 50 currently intends to display. If the time information from the content server 50 is not received by the reference time detection unit 11, the process proceeds to step ST9 for setting a frame display time.

[0044]

Next, in step ST3, the comparison unit 16 acquires the internal time information from the hardware clock operating in the video information reproduction device 30 and compares the time information of the content server received by the reference time detection unit 11 with the internal time information; and then, in step ST4, the comparison unit calculates the time difference ΔT(ms) between the internal time and the reference time. The internal time information is stored in the storage 17.

[0045]

Here, let the time information of the content server 50 be the reference time, and the time information of the video information reproduction device 30 be the internal time. Then, the time difference ΔT is calculated by the following equation 1.

[Equation 1]

ΔT = internal time − reference time

Hereinafter, the time difference ΔT denotes a value in unit of “ms”.

[0046]

Next, in step ST5, ΔT value is checked. When ΔT takes a value exceeding a predetermined threshold other than zero to indicate that correction is necessary, the process proceeds to step ST6. When ΔT is equal to or smaller than the predetermined threshold, the process proceeds to step ST9 because time correction is not necessary. Note that, because the video information reproduction device according to Embodiment 1 of the present invention adjusts the delay time by increasing or decreasing the frames, the time adjustment is performed in a discontinuous manner. Therefore, when ΔT takes a value other than zero, and is smaller than a half of the frame display time to be increased or decreased, only increasing or decreasing one certain frame would rather expand the time difference. Thus, the threshold may be set, for example, as a half of the frame’s display time. By this setting, a time

difference smaller than the threshold allows the process to proceed to step ST9 without performing any adjustment. Needless to explain, however, the larger the number of the frames capable of being displayed per second, the finer time adjustment capable of being performed by increasing or decreasing the certain multiple frames.

[0047]

If there is a difference between the reference time and the internal time so that correction is necessary, firstly the comparison unit 16 determines whether ΔT is positive or negative. Then, the output time controller 19 determines the display time on the basis of the value of ΔT. Using as a unit the frame period at which the display can display frames, the frame's display time is varied in accordance with the difference correction amount A which is an integral multiple of the frame period and does not cause a frame drop on the display. If a display can display frames at a frame rate of 60 fps, an integral multiple of 16.7 ms will be the difference correction amount A.

[0048]

In a case where a video data source with a frame rate of 30 fps is to be displayed by a display which can display frames at a frame rate of 60 fps, if the video information reproduction device 30 is 33.3 ms behind the reference time, the 33.3 ms delay can be eliminated by cutting the display time to 16.7 ms for each of two flames by displaying only one frame for each of the two frames, each of which originally has to be displayed as two frames.

[0049]

When ΔT is negative, namely the internal time is behind, and if the difference is equal to or larger than 16.7 ms, the difference is distributed to one or multiple frames for time correction. If the difference is smaller than 16.7 ms, the time correction will not be performed until the difference becomes larger than 16.7 ms.

[0050]

When ΔT is positive, namely the internal time is ahead, and if the difference is equal to or larger than 16.7 ms, the difference is distributed to one or multiple frames for time correction. If the difference is smaller than 16.7 ms, the time correction will not be performed until the difference becomes equal to or larger than 16.7 ms.

[0051]

If the time difference ΔT takes a value between ±16.7 ms, the time correction may be performed when ΔT becomes larger than 8.3 ms, a half of 16.7 ms. If time correction is performed whenever a difference larger than 8.3 ms is detected, the difference from the reference time is kept between ±8.3 ms all the time, which improves the time correction accuracy.

[0052]

In step ST6, the difference correction amount A is determined. When the time difference ΔT exceeds the range between ±16.7 ms, determination is made about the

difference correction amount A, the number B of display frames expressed in a unit of the displaying-device side, and a carryover error C. Here, the time difference ΔT is indicated by Equation 2.

[Equation 2]

ΔT = B frames × 16.7 ms + C

B and C are determined so as to satisfy Equation 2, to display for a time corresponding to B frames added to or subtracted from the original display time. Here, C is a residual amount smaller than 16.7 ms. Thus, the difference correction amount A is calculated as Equation 3, by which amount the time difference ΔT will be corrected.

[Equation 3]

The difference correction amount A = B frames ×16.7 ms

In the same manner, to improve time correction accuracy, determination may be made about the difference correction amount A, the number B of display frames, and the carryover error C for a case where the time difference ΔT exceeds the range between ±8.3 ms. In this case, the time difference ΔT is calculated according to Equation 4.

[Equation 4]

ΔT = B frames × 16.7 ms + C

B and C are determined so as to satisfy Equation 4, to display for a time corresponding to B frames added to or subtracted from the original display time. Here, C is a residual amount smaller than 16.7 ms. Thus, the difference correction amount A is calculated as Equation 5, by which amount the time difference ΔT will be corrected.

[Equation 5]

The difference correction amount A = B frames ×16.7 ms

[0053]

In step ST7, the comparison unit 16 detects a currently displayed frame. In the video information reproduction device according to Embodiment 1 of the present invention, synchronization with the preset display time of each frame's video data is not performed. Therefore, the currently displayed frame content is unknowable from only its reproduction time. To cope with this, the frame number of the currently displayed frame is obtained and stored in the storage 17.

[0054]

In step ST8, the time of the hardware clock of the video information reproduction device 30 is corrected by adding the difference correction amount A to or subtracting it from the original display time. By reproducing video without referring to display time information included in the video data, the video reproduction is controlled so as not to drop a frame, and the video reproduction is free from video interruption and disturbance caused by a frame drop. In case of a frame drop, the time difference can be corrected immediately.

[0055]

In step ST9, the output time controller 19 determines the reproduction times of frames in accordance with the difference correction amount A determined in step ST6. When compared with the preset frame display time (typically 33.3 ms), if the time is behind, the reproduction time of the next frame is set to be [33.3 ms – the difference correction amount A], and if the time is ahead, the reproduction time of the next frame is set to be [33.3 ms + the difference correction amount A]. Here, the frame reproduction time is set so as to prevent a frame from dropping. If the time is behind, the difference correction amount A is determined so that the reproduction time of the next frame will not become zero. If the time is ahead, the display time will be extended over the consecutive multiple frames so that the smoothness of the video reproduction will not be disturbed. For example, if the time is 166 ms ahead, each of the next consecutive 10 frames will be displayed for 50.0 ms (33.3 ms +16.7 ms) instead of displaying the next one frame for 199.3 ms (33.3 ms +166 ms). If a frame drop occurs, the time difference can be corrected immediately.

[0056]

Next, in step ST10, the output time measuring unit 20 measures the reproduction time of the next frames determined in step ST9 and the display 22 displays the video. Here, in step ST11, whether to end the sequence is determined. If the video data has been reproduced to the end, the sequence is ended. If the video data has not been reproduced to the end, the process returns to step ST2 to restart the processing.

[0057]

Fig. 7 is a flowchart showing a processing sequence of the content server for the video information reproduction devices 30.

[0058]

For example, when a control device which is set up in advance by a signage installer, etc. requests the content server 50 to transmit data for starting reproduction, the content server 50 starts broadcasting video data to the video information reproduction devices 30. This reproduction start request may be performed by transmission of a signal from any of the video information reproduction devices. When the above request is issued, the processing of the content server proceeds to step ST20, and the content server starts video data transmission to the data receiver 10 of each video information reproduction device.

[0059]

Next, in step ST21, when it is determined that ten seconds have elapsed from the start of the video data transmission on the basis of the server time, then, in step ST22, the time information of the content server 50 to which the multiple video information reproduction devices refer as their reference time is transmitted to the reference time detection units 11 of the multiple video information reproduction devices. If ten seconds have not elapsed yet, the process proceeds to step ST23. Although the explanation here has been made taking “10 seconds” as an example, it

goes without saying the time may be set as 5 seconds, 15 seconds, 20 seconds, 30 seconds, and any other time period which is not limited to a multiple of 5 seconds.

[0060]

After the step ST22 ends, the process proceeds to step ST23. When the video information data has been reproduced to the end, the sequence ends. When the video data has not been reproduced to the end, the process returns to step ST20 to start over the processing.

[0061]

As explained above, by using a display capable of reproducing video at a frame rate higher than that of the received video data, the video reproduction timing correction becomes possible by adding or deleting frames to be displayed when a difference is detected between the reference time and the internal time of the video information reproduction device.

[0062]

According to Embodiment 1, the time information of the content server 50 is compared with time information used as a reference for display control of the video information reproduction device 30. When a delay or advance in video reproduction timing is detected against the content server 50, the detected time difference can be immediately reduced by varying the display time of the frames from that of the received video data.

[0063]

Furthermore, this method is effective in reducing the processing load of the content server because the content server does not perform any processing to the video data on itself, and allows the stored video data to be distributed as it is.

[0064]

Also, because this method varies the display times of the frames of the video data from their original display times allocated for the frames in the received video data, time synchronization with the reference time can be achieved without causing a frame drop. This means that the method is effective in providing smoother video reproduction.

[0065]

The video information reproduction devices according to Embodiment 1 of the present invention synchronize multiple displays such as those installed in a vehicle, a streetcar, a bus and a railway train and so on, and displays used with surveillance cameras, thereby obtaining an effect that reproduction times among the displays to display video can be synchronized with high accuracy.

[0066]

Embodiment 2

Fig. 8 is a block diagram schematically showing video information reproduction devices and a video information reproduction system which includes multiple video information reproduction devices. In Embodiment 1, a content server serves to distribute video data. In Embodiment 2 of the present invention, a single

representative of the video information reproduction devices serves to distribute video data. Hereinafter, explanation will be made using drawings. In the figure, a fifth video information reproduction device 35 distributes data to a first video information reproduction device 31, a second video information reproduction device 32, a third video information reproduction device 33, and a fourth video information reproduction device 34 via a network 51 which is configured, for example, as LAN (Local Area Network: hereinafter, may be referred to as only LAN). Here, the first video information reproduction device 31, the second video information reproduction device 32, the third video information reproduction device 33, the fourth video information reproduction device 34, and the fifth video information reproduction device 35 are the same ones, and the fifth video information reproduction device 35 distributes video data, which the other video information reproduction devices each receive.

[0067]

In Embodiment 1, the reference time of each video information reproduction device 30 is set as that of an external device, the content server 50. But, after calculating the average of the internal times of the network-connected devices, namely the first video information reproduction device 31, the second video information reproduction device 32, the third video information reproduction device 33, the fourth video information reproduction device 34, and the fifth video information reproduction device 35, the closest internal time to the calculated average among the internal times of the first video information reproduction device 31, the second video information reproduction device 32, the third video information reproduction device 33, the fourth video information reproduction device 34, and the fifth video information reproduction device 35, may be regarded as the reference time.

[0068]

Fig. 9 is a block diagram showing the video information reproduction device according to Embodiment 2 of the present invention which is, here, the fifth video information reproduction device. In the figure, the units and the devices whose symbols are the same as in Embodiment 1 are units and devices having the same configuration as explained in Embodiment 1. Therefore, their detailed explanation will be omitted here. A data transmitter 24 distributes data including internal time information to video information reproduction devices other than the fifth video information reproduction device 35, namely, to the first video information reproduction device 31, the second video information reproduction device 32, the third video information reproduction device 33, and the fourth video information reproduction device 34. The time information transmission of the internal time is performed, for example every ten seconds. Although the explanation here has been made taking “10 seconds” as an example, it goes without saying that the time may be set as 5 seconds, 15 seconds, 20 seconds, 30 seconds, and any other time period which is not limited to a multiple of 5 seconds.

[0069]

From each of the first video information reproduction device 31, the second video information reproduction device 32, the third video information reproduction device 33, the fourth video information reproduction device 34, and the fifth video information reproduction device 35, a reference time determination unit 25 receives, via the network 51 shown in Fig.8, a signal including the time information of the internal time of the corresponding video information reproduction device and ID information for identifying the corresponding video information reproduction device, and then detects a video information reproduction device whose internal time information is the closest to the average, to thereby determine the reference time.

[0070]

With the configuration explained above, the video information reproduction device according to Embodiment 2 of the present invention can have the same effect as brought in Embodiment 1, without using a content server, but by making one of the network-connected first video information reproduction device 31, second video information reproduction device 32, third video information reproduction device 33, fourth video information reproduction device 34, and fifth video information reproduction device 35, serve as the content server.

[0071]

Furthermore, in the video information reproduction devices according to Embodiment 2 of the present invention, the video data stored in the fifth video information reproduction device 35 can be distributed, without using a content server, to the first video information reproduction device 31, the second video information reproduction device 32, the third video information reproduction device 33, and the fourth video information reproduction device 34 to be synchronously reproduced. Here, a case has been explained where the fifth video information reproduction device 35 serves as a content server. However, other one or multiple devices among the first video information reproduction device 31, the second video information reproduction device 32, the third video information reproduction device 33, and the fourth video information reproduction device 34 may serve as content servers. Also here, a case has been explained where five video information reproduction devices are connected with the network. Not to mention, the same effect will be obtained even in a case where more than five devices, for example six, seven, ten or more devices, or less than five devices, for example two, three, or four devices, are connected.

Description of Symbols

[0072]

10: data receiver

11: reference time detection unit

13: data storage

14: reproduction controller

15: video decoder

16: comparison unit

17: storage

18: output update unit
19: output time controller
20: output time measuring unit
21: bus
22: display
23: video reproduction processing unit
24: data transmitter
25: reference time determination unit
30: video information reproduction devices
31: first video information reproduction device
32: second video information reproduction device
33: third video information reproduction device
34: fourth video information reproduction device
35: fifth video information reproduction device
50: content server
51: network

CLAIMS

1. A video information reproduction device comprising:

a time information detector to receive a signal including video data and control data thereof via a network and to acquire time information included in the control data;

an internal time detector to detect internal time measured by an internal clock;

a comparison unit to compare time given by the time information acquired by the time information detector and the internal time measured by the internal time detector;

a frame controller to control, on the basis of the comparison result of the comparison unit, the number of frames to be displayed based on the number of frames per unit time of the video data and the number of frames to be displayed corresponding to a single frame of the video data, to be equal to or larger than one; and

a display capable of displaying frames at a rate higher than a frame rate of the video data.

2. The video information reproduction device according to claim 1, wherein the frame controller controls, when performing video reproduction, video to be switched asynchronously to reproduction display times included in the respective frames of the video data.

3. The video information reproduction device according to claim 1 or 2, wherein the frame controller varies a frame output time to an integral multiple of a frame rate at which the display is capable of displaying frames.

4. A video information reproduction method comprising:

a step of receiving a signal including video data and control data thereof via a network;

a step of acquiring time information included in the control data;

a step of detecting internal time measured by an internal clock;

a step of comparing time given by the time information and the internal time;

a step of controlling, on the basis of the comparison result, the number of frames to be displayed based on the number of frames per unit time of the video data and the number of frames to be displayed corresponding to a single frame of the video data, to be equal to or larger than one; and

a step of displaying frames at a rate higher than a frame rate of the video data.