METHOD AND APPARATUS FOR PROVIDING A VIDEO SIGNAL

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U.S. PATENT DOCUMENTS
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5,457,609 A 10/1995 Kim et al.
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ABSTRACT

A method of providing a video signal for display of a stream of video data (20) at a rate other than real-time, the video data being built up from frames, includes real-time rendering of non-contiguous segments of the stream of video data having multiple subsequent frames to a first rendered stream, non-real-time rendering of the stream of video data by rendering pre-determined non-subsequent frames at a speed other than real-time to a second rendered stream; and multiplexing the first rendered stream and the second rendered stream for simultaneous display on a display device (150), wherein the first rendered stream is displayed on a first part (310) of the display device, and the second rendered stream is displayed on a second part (320) of the display device.

12 Claims, 2 Drawing Sheets
METHOD AND APPARATUS FOR PROVIDING A VIDEO SIGNAL

FIELD OF THE INVENTION

The invention relates to a method of providing a video signal for display of a stream of video data at a rate other than real-time, the video data being built up from frames, the method comprising the step of real-time rendering of non-contiguous segments of the stream of video data comprising multiple subsequent frames to a first rendered stream.

The invention further relates to an apparatus for providing a video signal for display of a stream of video data at a rate other than real-time, the video data being built up from frames, the method comprising a first rendering unit for real-time rendering of non-contiguous segments of the stream of video data comprising multiple subsequent frames to a first rendered stream.

The invention also relates to a record carrier comprising computer executable code.

Furthermore, the invention relates to a programmed computer.

DESCRIPTION OF THE RELATED ART

An embodiment of the aforementioned method is known from the granted U.S. Pat. No. 5,457,669. This patent discloses a program search method including the steps of reproducing the program for a predetermined reproduction period after performing a jump step by a predetermined search interval and repeatedly performing the jumping and reproducing steps.

A disadvantage of such a method is that a user easily loses track of the location at which the program is reproduced. This is especially the case when there are frequent scene changes and/or a large search interval. First, a user will easily lose any understanding of the search direction. Second, the user might miss some scenes, especially in case of frequent scene changes and a large search interval and in that way, lose the global understanding of the program.

SUMMARY OF THE INVENTION

It is an objective of the invention to provide better user feedback using the aforementioned method.

This object is achieved with the method according to the invention, characterized in that the method further comprises the step of: non-real-time rendering of the stream of video data by rendering pre-determined non-subsequent frames at a speed other than real-time to a second rendered stream; multiplexing the first rendered stream and the second rendered stream for simultaneous display on a display device, wherein the first rendered stream is displayed on a first part of the display device, and the second rendered stream is displayed on a second part of the display device.

By non-real-time rendering of the stream of video data by rendering pre-determined non-subsequent frames at a speed other than real-time, a stream is obtained as is usually obtained when, for example, fast-forwarding a film on a standard DVD player. In such a stream, the direction of the playback can easily be seen, for example, when a person is shown who is walking backward instead of forward, especially at playback speeds which are not too high. This type of playback, however, has the disadvantage that it is very difficult to render synchronously with audio, while playback with audio increases the information delivered to a user. Therefore, rendering of two streams is provided in the method according to the invention.

In an embodiment of the method according to the invention, the second part of the display device is significantly smaller than the full size of the display device and the first part of the display is the complement to the second part.

An advantage of this embodiment is that the real-time rendered part of the stream, which is usually the most convenient to view for the user, of data is provided on a large area. The second rendered stream is provided only for navigation and orientation purposes to provide a global impression. Therefore, it is not a big problem to provide this on a small part of the display device.

A further embodiment of the method according to the invention comprises the steps of providing a first bar representative of the stream of video data and indicating, on the first bar, a location of the first rendered stream that is displayed on the first part of the display device.

An advantage of this embodiment is that a user is given an indication which part of the stream of audiovisual data is rendered and shown on a screen.

Alternatively, an embodiment according to the invention further comprises the steps of providing a second bar representative of the stream of video data and indicating, on the second bar, a location of the second rendered stream that is displayed on the second part of the display device.

Another embodiment of the method according to the invention comprises the step of providing an indicator indicative of the direction of the non-real-time rendering.

The apparatus according to the invention is characterized in that the apparatus further comprises a second rendering unit for non-real-time rendering of the stream of video data by rendering pre-determined non-subsequent frames at a speed other than real-time to a second rendered stream; and a multiplexer for multiplexing the first rendered stream and the second rendered stream for simultaneous display on a display device, wherein the first rendered stream is displayed on a first part of the display device; and the second rendered stream is displayed on a second part of the display device.

With respect to the record carrier according to the invention, the computer executable code enables a processing unit to perform the method according to claim 1.

The programmed computer according to the invention is enabled to execute the method according to claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be further elucidated by describing embodiments depicted in Figs., wherein:

FIG. 1 shows a consumer electronics system comprising an embodiment of the apparatus according to the invention;

FIG. 2 shows a stream of audiovisual data to elucidate an embodiment of the method according to the invention;

FIG. 3A shows a screen to depict an embodiment of the method according to the invention;

FIG. 3B shows a screen to depict another embodiment of the method according to the invention;

FIG. 4A shows a screen to depict a further embodiment of the method according to the invention;

FIG. 4B shows a screen to depict yet another embodiment of the method according to the invention; and

FIG. 5 shows a screen to depict yet a further embodiment of the method according to the invention.
DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a consumer electronics system comprising a video processing apparatus as an embodiment of the apparatus according to the invention, a TV-set and a user control device.

The video processing apparatus comprises a harddisk drive as an embodiment of a storage device, a buffer, a first rendering unit, a second rendering unit, a video multiplexing unit, a micro-controller for controlling the components of the video processing apparatus, a ROM memory and a user control command receiver.

The TV-set comprises two speakers and a screen as a display device.

The user control device comprises a fast-rewind button, a fast-forward button, a pause button and a stop button.

When performing fast trickplay—fast-forward or fast-rewind—while displaying video data on the screen according to the invention, data is retrieved from the harddisk drive and stored in the buffer. It should be mentioned that the buffer is optional, i.e., data can also be read directly from the harddisk drive. A buffer is, however, preferred since in that case, data has to be read only once from the harddisk drive, as will be apparent from the further description.

Using the method according to the invention, at least two rendered streams are produced. A first rendered stream is produced by real-time rendering of non-contiguous segments of the stream of video data comprising multiple subsequent frames by the first rendering unit. Also, a second stream is produced by non-real-time rendering of the stream of video data by rendering pre-determined non-subsequent frames at a speed other than real-time by the second rendering unit.

To execute the method according to the invention, the rendering units are controlled by the micro-controller for controlling the components of the video storage apparatus. The instructions for the micro-controller for executing the method according to the invention are, in this embodiment, stored in the ROM memory as an embodiment of a computer-readable medium according to the invention.

The operation of the video processing apparatus and embodiments of the method according to the invention will be elucidated by FIG. 1 and FIG. 2 depicting a stream of video data. The stream of video data is built up from frames.

When a user instructs the video processing apparatus to render a stream of video data at a speed higher than real-time in fast-forward mode, the user presses the fast-forward button on the user control device. The user command is received by the user control command receiver which forwards it to the micro-controller. The micro-controller instructs the buffer to retrieve a first portion of the video stream. The retrieved portion of the video stream is then played back to the user.

Next, a part of the first portion of the stream is retrieved between the left-most arrow and right-most arrow of the first indicator. The retrieved portion of the video stream is then played back to the user.

Simultaneously, pre-determined non-subsequent frames of the first portion of the stream are retrieved from the buffer and rendered by the second rendering unit to provide a second rendered stream with the same pre-determined duration as the first rendered stream. The pre-determined frames are, for example, intra-coded frames when the stream is encoded according to the MPEG (Motion Pictures Expert Group) standard. In FIG. 2, they are, for the first portion, indicated by a first arrow, a second arrow, a third arrow and a fourth arrow.

The second and the first streams are rendered simultaneously. This means that as the first frame of the segment indicated by the first indicator is rendered to the rendered first stream, the frame indicated by the first arrow is rendered to the second rendered stream. Furthermore, as the second indicator is rendered, the frames indicated by the second arrow, the third arrow and the fourth arrow are rendered to the second rendered stream. Subsequently, the first frame of the segment indicated by the second indicator is rendered simultaneously with the frame indicated by a fifth arrow.

This is the point where the advantage of the buffer comes in. When the first portion of the stream is retrieved directly from the harddisk drive by both rendering units individually, the harddisk drive is busy for a longer time, since during rendering to obtain the second rendered stream multiple frames continuously have to be retrieved. When they are retrieved at once, the harddisk drive is available for further processes.

Advantageously, only the part of the first portion of the stream between the left-most arrow and right-most arrow of the first indicator and the frames indicated by the first arrow, the second arrow, the third arrow and the fourth arrow are buffered.

When the first portion of the stream between the left-most arrow and right-most arrow of the first indicator and the pre-determined frames of the first portion are rendered, a second portion of the stream between a fifth arrow and a later arrow is retrieved from the harddisk drive and stored in the buffer for further rendering.

Both rendered streams are sent to the video multiplexing unit where they are multiplexed to be displayed simultaneously on the screen, wherein each rendered stream is displayed in a pre-determined part of the screen.

Advantageously, sound is rendered and provided to the TV-set as well, accompanying the first rendered stream. The sound is provided to a user via the two speakers. The sound is provided at the speed of the first stream, which is preferably real-time.

It will be apparent to a person skilled in the art that additional features are needed for properly providing a signal to the TV-set, like a D/A converter. However, since they are apparent, they have been omitted in FIG. 1 for sake of simplicity and overview.

When the stream is compressed and/or encrypted, the multiplexing may take place either in the compressed and/or encrypted domain, or in the non-compressed and/or decrypted domain. In the first case, the rendering units are replaced by simple processing units retrieving the proper frames from the buffer and the actual rendering is done after multiplexing. In this case, an additional rendering unit (not shown) has to be inserted in the video processing apparatus.

In the latter case, the decryption and/or decompression is performed by the rendering units or by separate decryption and/or decompression units that are placed between the hard-
disk drive 112 and the rendering units. There are several embodiments for this: in one embodiment, one rendering unit (not shown) is placed between the hard disk drive 112 and the buffer 114. In a further embodiment, a first decoding (or decompression) unit is placed between the buffer 114 and the first rendering unit 116 and a second first decoding (or decomposition) unit is placed between the buffer 114 and the second rendering unit 116. This kind of additions to and permutations of the elements of the embodiment described are obviously by a person skilled in the art and can be performed without departing from the scope of the invention.

When the stream of video data 200 is displayed using the method according to the invention, wherein each rendered stream is displayed on a pre-determined part of the display device 154, various embodiments are possible, some of which are presented in FIG. 3A and FIG. 3B.

FIG. 3A shows the TV-set 150 with the screen 154 on which a first part 310 and a second part 320 are indicated, both parts occupying half the area of the screen to elucidate an embodiment of the method according to the invention. A first rendered stream obtained by real-time rendering of non-contiguous segments of a stream of video data comprising multiple subsequent frames is displayed on the first part 310 and a second rendered stream obtained by non-real-time rendering of the stream of video data by rendering pre-determined non-subsequent frames at a speed higher than real-time is displayed on the second part 320.

FIG. 3B shows the TV-set 150 with the screen 154 on which a first part 340 and a second part 350 are indicated to elucidate a further embodiment of the method according to the invention, wherein the second part 350 is substantially smaller than the first part 340. A first rendered stream obtained as described in the previous paragraph is displayed on the first part 340 and a second rendered stream obtained as described in the previous paragraph is displayed on the second part 350.

It will be apparent for a person skilled in the art that a further embodiment of the invention is possible, wherein the first rendered stream is displayed on the second part 350 and the second rendered stream is displayed on the first part 340. In another embodiment, a user may even switch between both modes described here, swap the displayed streams in the first part 340 and the second part 350.

To further enhance navigation of a user through a stream of video data during playback wherein the stream is displayed using an embodiment of the method according to the invention, navigation bars are introduced according to an embodiment of the invention. This is elucidated by FIG. 4A and FIG. 4B.

FIG. 4A shows the TV-set 150 with the screen 154 on which a first part 410 and a second part 420 are indicated. A first rendered stream obtained as described above is displayed on the first part 410 and a second rendered stream obtained as described above is displayed on the second part 420. Furthermore, a first bar 412 with a first indicator 414 and a second bar 422 with a second indicator 424 are displayed on the screen 154.

Both bars represent at least a portion of a stream of video data that is displayed on the screen 154. The first bar 412 is displayed on the first part 410 of the screen 154 and the first indicator 414 indicates the location at which the stream of video data is displayed on the first part 410. The second bar 422 is displayed on the second part 420 of the screen 154 and the second indicator 424 indicates the location at which the stream of video data is displayed on the second part 420.

FIG. 4B shows the TV-set 150 with the screen 154 on which a first part 440 and a second part 450 are indicated. A first rendered stream obtained as described above is displayed on the first part 440 and a second rendered stream obtained as described above is displayed on the second part 450. Furthermore, a bar 462 with a first indicator 464 and a second indicator 466 are displayed on the screen 154.

The bar 462 represents at least a portion of a stream of video data that is displayed on the screen 154. The first indicator 464 indicates the location at which the stream of video data is displayed on the first part 440. The second indicator 466 indicates the location at which the stream of video data is displayed on the second part 450.

In a further embodiment borders with different colors are placed around the first part 440 and the second part 450. A color surrounding the first part corresponds with the first indicator 464 and a color surrounding the second part corresponds with the second indicator 466.

When non-contiguous segments of a stream of video data are to be displayed in real-time using the method according to the invention, it might be difficult for a user to keep track of the direction in which the video data is rendered, i.e., backward or forward. To facilitate the user feedback, in an embodiment of the invention, an indicator is provided that indicates the direction of the rendering. This indicator, for example, has the shape of an arrow, pointing either to the left side (backward rendering) or to the right side (forward rendering).

This is indicated in FIG. 5, depicting the TV-set 150 with the screen 154, a first region 510, a second region 520 and an indicator 530 indicating that the rendering direction of the video is forward.

It will be apparent to any person skilled in the art that numerous variations based on the embodiments described are possible without departing from the scope of the invention. Process steps performed by multiple elements can be grouped and performed by only one processing element and on the other hand, processing steps performing multiple steps in the embodiments may just as well be taken apart and performed by multiple processing blocks. This also means that all process steps can be performed by a single processor of a programmed computer.

In summary, the invention relates to a method of providing a video signal for display of a stream of video data at a rate other than real-time, the video data being built up from frames, the method comprising the step of real-time rendering of non-contiguous segments of the stream of video data comprising multiple subsequent frames to a first rendered stream; wherein the method further comprises the step of non-real-time rendering of the stream of video data by rendering predetermined non-subsequent frames at a speed higher than real-time to a second rendered stream; multiplexing the first rendered stream and the second rendered stream for simultaneous display on a display device, wherein the first rendered stream is displayed on a first part of the display device; and the second rendered stream is displayed on a second part of the display device.

The invention claimed is:

1. A method of providing a video signal for display of a stream of video data at a rate other than real-time, the stream of video data being built up from subsequent frames, the method comprising the steps of:

   - selecting a plurality of non-contiguous segments of the stream of video data, each of said non-contiguous segments comprising multiple subsequent frames;

   - real-time rendering said plurality of non-contiguous segments in a concatenated manner to form a first rendered stream having a first rate other than real-time;
selecting a plurality of pre-determined non-subsequent frames of said stream of video data; non-real-time rendering said pre-determined non-subsequent frames in a concatenated manner to form a second rendered stream having a second rate other than real-time; and multiplexing the first rendered stream and the second rendered stream for simultaneous display on a display device, wherein the first rendered stream is displayed on a first part of the display device and the second rendered stream is displayed on a second part of the display device; and wherein the second rate is greater than the first rate and real-time.

2. The method according to claim 1, wherein the second part of the display device is significantly smaller than the full size of the display device and the first part of the display is the complement to the second part.

3. The method according to claim 1, wherein the first part of the display device is significantly smaller than the full size of the display device and the second part of the display is the complement to the second part.

4. The method according to claim 1, wherein the first part of the display device and the second part of the display device have mutually equal sizes.

5. The method according to claim 1, wherein the method further comprises the steps of: providing a first bar representative of the stream of video data; and indicating on the first bar a location in the stream of video data of the first rendered stream that is displayed on the first part of the display device.

6. The method according to claim 1, wherein the method further comprises the steps of: providing a second bar representative of the stream of video data; and indicating on the second bar a location in the stream of video data of the second rendered stream that is displayed on the second part of the display device.

7. The method according to claim 5, wherein the method further comprises the step of: indicating on the first bar a location in the stream of video data of the second rendered stream that is displayed on the second part of the display device.

8. The method according to claim 1, wherein the method further comprises the step of: providing an indicator indicative of a direction of the non-real-time rendering.

9. The method according to claim 1, further comprising the step of: providing an audio signal at real-time, synchronized with the first rendered stream.

10. An apparatus for providing a video signal for display of a stream of video data at a rate other than real-time, wherein video data being built up from subsequent frames, the apparatus comprising:
first means for selecting a plurality of non-contiguous segments of the stream of video data, each of said plurality of non-contiguous segments comprising multiple subsequent frames;
a first rendering unit for real-time rendering the plurality of non-contiguous segments in a concatenated manner to form a first rendered stream having a first rate other than real-time;
second means for selecting a plurality of pre-determined non-subsequent frames of said stream of video data;
a second rendering unit for non-real-time rendering of the plurality of pre-determined non-subsequent frames in a concatenated manner to form a second rendered stream having a second rate other than real-time; and a multiplexer for multiplexing the first rendered stream and the second rendered stream for simultaneous display on a display device, wherein the first rendered stream is displayed on a first part of the display device and the second rendered stream is displayed on a second part of the display device; and wherein the second rate is greater than the first rate and real-time.

11. A non-transitory computer-readable storage medium having stored thereon executable instructions configured for being executed by at least one processor for performing a method suitable for providing a video signal for display of a stream of video data at a rate other than real-time, wherein the stream video data being built up from subsequent frames, the method comprising:
Selecting a plurality of non-contiguous segments of the stream of video data, each of said plurality of non-contiguous segments comprising multiple subsequent frames; non-real-time rendering of the plurality of non-contiguous segments in a concatenated manner to form a first rendered stream having a first rate other than real-time; selecting a plurality of pre-determined non-subsequent frames of said stream of video data; non-real-time rendering of the plurality of pre-determined non-subsequent frames in a concatenated manner to form a second rendered stream having a second rate other than real-time; and multiplexing the first rendered stream and the second rendered stream for simultaneous display on a display device, wherein the first rendered stream is displayed on a first part of the display device and the second rendered stream is displayed on a second part of the display device; and wherein the second rate is greater than the first rate and real-time.

12. A method of providing a video signal for display of a stream of video data at a rate other than real-time, wherein the stream of video data being built up from subsequent frames, the method comprising the steps of:
Selecting a plurality of non-contiguous segments of the stream of video data, each of said plurality of non-contiguous segments comprising multiple subsequent frames; non-real-time rendering of the plurality of non-contiguous segments in a concatenated manner to form a first rendered stream having a first rate other than real-time; selecting a plurality of pre-determined non-subsequent frames of said stream of video data; non-real-time rendering of the plurality of pre-determined non-subsequent frames in a concatenated manner to form a second rendered stream having a second rate other than real-time; and multiplexing the first rendered stream and the second rendered stream for simultaneous display on a display device, wherein the first rendered stream is displayed on a first part of the display device and the second rendered stream is displayed on a second part of the display device; and wherein the second rate is greater than the first rate and real-time.
providing a first bar representative of the stream of video data;
indicating on the first bar a location in the stream of video data of the first rendered stream that is displayed on the first part of the display device; and

indicating on the first bar a location in the stream of video data of the second rendered stream that is displayed on the second part of the display device.