(54) Title: ADDING AUDIO-VISUAL DATA TO PREVIOUSLY RECORDED AUDIO-VISUAL DATA ON DISK MEDIUM

(57) Abstract: A method for configuring a recordable medium to store subsequently added data to previously recorded multiplexed audio-visual data can include multiplexing original audio-visual data and navigation data into a composite data stream; recording the composite data stream to packs in a recordable medium; and, subsequently recording supplemental data corresponding to the original audio-visual data in the reserved packs. The method can further include designating the recorded packs as reserved packs that can accept subsequently recorded supplemental data; and, subsequently recording supplemental audio-visual data in the reserved packs, re-designating the packs according to whether the reserved packs contain supplemental sub-picture, audio or video data. Notably, the first three steps of the method can occur in an initial recording session while the fourth step can occur in an editing session. Alternatively, all of the steps can occur in a single recording session.
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ADDITION AUDIO-VISUAL DATA TO PREVIOUSLY RECORDED
AUDIO-VISUAL DATA ON DISK MEDIUM

BACKGROUND OF THE INVENTION

Technical Field

The inventive arrangements relate generally to recordable media, for example recordable digital versatile discs, hard drives and magneto optical discs, and more particularly to a method and apparatus for configuring a recordable medium to store subsequently added audio-visual data to previously recorded multiplexed audio-visual data.

Description of the Related Art

Various devices have been developed to enable consumers to record video and/or audio programs for later presentation. Such devices include tape recorders, video cassette recorders, recordable compact disks, and most recently, recordable digital versatile disks (DVD). Hard drives and magneto optical disks have also been used. A DVD in which data can be recorded once only, and thereafter is essentially a DVD read only memory, is referred to by the acronym DVD-R. The acronym DVD-R also has been used generally to refer to write-once, or record-once, technology.

In contrast to DVD-R, several formats exist in which data can be recorded to a DVD, erased and re-recorded. In sum, such a DVD can be overwritten or rewritten. These DVDs typically are referred to by the acronyms DVD-RAM, DVD-RW and DVD+RW. Although, as of this time no uniform industry standard has been adopted, the acronyms DVD-RAM, DVD-RW and DVD+RW have been used generally to refer to the respective re-writable DVD technologies. Still, reference herein to re-writable DVD technology, devices and methods and recordable DVD media is generally intended to encompass all of the standards which are now being used, as well as those which may be developed in the future.

Present DVDs can have a logical file structure in which audio-video content can be stored. Specifically, as shown in Figure 8, at the top of the file structure hierarchy of a DVD 800, one or more titles 801 can exist which can
loosely correlate to program episode titles. Titles 801 can consist of control data
802 in addition to one or more Video Object Sets 803 (VOBS). The control data
802 can contain information for managing the title 801. Each VOBS 803 can
include a plurality of Video Objects (VOB) 804. Each VOB 804 preferably
includes a plurality of Cells 805. Each Cell 805 preferably includes a plurality of
Video Object Units (VObU) 806. Each VObU 806 roughly correlates to a group
of pictures which is the smallest addressable chunk in the DVD 800.

Notably, each VObU 806 can contain an integer number of video frames,
typically 15 frames. As such, each VObU 806 can contain 0.4 to 1.0 seconds
of presentation material. A typical VObU 806 in a commercial motion picture
can contain 0.5 second of presentation material. Additionally, each VObU 806
can include a sequence of packs 807 positioned in recording order and
interleaved according to the different types of data streams which are
multiplexed together into a composite data stream. The packs 807 can be MPEG
compliant packs which can include system clock reference information for timing
and synchronization. Also, each pack 807 can identify a corresponding data
stream, for example navigation, audio, video or sub-picture. Finally, each pack
807 can store therein a chunk of data for that corresponding data stream.

Different packs 807 can contain data for navigation, video, audio and sub-
picture. Specifically, each VObU can begin with a navigation pack 808 (NV_PCK
or NAV_PACK) which can be followed by audio-visual data packs 809, for
example video packs (V_PCK), audio packs (A_PCK) and sub-picture packs
(SP_PCK). The NV_PCK 808 can contain navigation information, which can be
useful in implementing trick modes of operation. The NV_PCK 808 also can
include presentation control information (PCI) and data search information (DSI).
In contrast, the audio-visual data packs 809 can contain audio-visual data in
addition to sub-picture data such as captioning or visual graphics.

When recording audiovisual data to a recordable medium like a recordable
DVD, audio, video and sub-picture data streams can be separately acquired and
encoded. Subsequently, the audio, video and sub-picture data streams can be
multiplexed into a composite MPEG stream and combined with navigation data.
Prior to physically recording the multiplexed stream to the recordable medium,
the MPEG stream further can undergo error correction coding. Finally, the MPEG stream can be physically written to the recordable medium.

In the case of a recordable DVD, for each VOBU 806 in which audiovisual data is recorded, the audio data in the multiplexed composite MPEG stream can be written to a series of A_PCKs, each A_PCK holding 2,048 bytes of data. Similarly, video data can be written to a series of V_PCKs, each V_PCK holding 2,048 bytes of data. Also, sub-picture data can be written to a series of SP_PCKs, each SP_PCK holding 2,048 bytes of data. Finally, each of the A_PCKs, V_PCKs and SP_PCKs can be interleaved in the VOBU according to an associated serial order in the multiplexed composite MPEG stream.

Notably, when recording audio-visual data in a VOBU 806, each consecutive audio-visual pack 809 can be filled with audio-visual data as needed to physically record audio-visual data in a composite MPEG stream. Also, because each VOBU 806 can only contain navigation, video, audio and sub-picture data, once a VOBU 806 has been recorded, it can be difficult to identify which of the audio-visual packs contain recorded data and which are empty. Hence, once audio-visual data has been recorded to a VOBU 806, it can be difficult to subsequently add additional audio-visual data to the same VOBU 806.

**SUMMARY OF THE INVENTION**

A method in accordance with the inventive arrangements allows users to customize a recordable DVD by editing sub-picture packs and/or audio packs. Certain audio packs and/or sub-picture packs are advantageously reserved in the multiplexed, recorded material. Using these pre-reserved packs, a user can record onto the disk different information at a later time, such as a song sung by the user or subtitles made by the user, while still keeping the original tracks intact. This has wide application, including for example Karaoke, audio dubbing of home videos, titling and graphics overlays.

In a first aspect of the present invention, a method for configuring a recordable medium to store subsequently added supplemental data to previously recorded multiplexed audio-visual data can include first, multiplexing original audio-visual data and navigation data into a composite data stream; second,
recording the composite data stream to packs in a recordable medium; third, further recording reserved packs in the recordable medium; and, fourth, subsequently recording supplemental data corresponding to the original audio-visual data in the reserved packs in the recordable medium. Notably, the recordable medium can be a re-writable DVD.

The multiplexing step can include multiplexing the original audio-visual data into an MPEG-compliant data stream; multiplexing the navigation data into the MPEG-compliant data stream; and, error correction encoding the MPEG-compliant data stream. The method can further include designating the recorded reserved packs as able to accept subsequently recorded data; and, subsequent to recording the supplemental audio-visual data in the reserved packs, re-designating the reserved packs according to whether the reserved packs contain supplemental sub-picture, audio or video data. The recording step can include recording the composite data stream to packs in a VOBU in the re-writable DVD.

Notably, the first three steps of the method can occur in an initial recording session while the fourth step can occur in an editing session. Alternatively, all of the steps can occur in a single recording session.

In a second aspect of the present invention, a method for configuring a recordable medium to store subsequently added data to previously recorded multiplexed audio-visual data can include first, multiplexing original audio and video data into a composite series of data packs in the recordable medium; second, adding reserved packs to the composite series of data packs in the recordable medium; and, third, subsequently writing supplemental data corresponding to the original audio and video data to the reserved packs in the composite series of data packs in the recordable medium. Notably, the recordable medium can be a re-writable DVD.

The method can further include multiplexing navigation data into the composite series of data packs in the recordable medium. Also, the method can include designating the reserved packs as able to accept subsequently recorded sub-picture, audio and video data; and, subsequent to writing the supplemental data in the reserved packs, re-designating the reserved packs according to whether the reserved packs contain supplemental sub-picture, audio or video
data. Finally, the first two steps can occur in an initial recording session while the third step can occur in an editing session. Alternatively, all of the three steps can occur in a single recording session.

A recordable medium can be configured to store subsequently added data to previously recorded multiplexed audio-visual data in accordance with the inventive arrangements. Specifically, the recordable medium can include a plurality of VOBU's, each VOBU having at least one navigation pack and at least one data pack for storing original audio-visual data; and, at least one reserved pack in at least one of the VOBU's. The reserved pack can be selectably designated as able to store subsequently recorded supplemental data corresponding to the original audio-visual data. Each data pack in the VOBU's can be one of an audio pack, a video pack and a sub-picture pack. Also the original multiplexed audio-visual data can be multiplexed in data packs in the VOBU's.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Figure 1 is a block diagram of a DVD recording device that can be provided with one or more advance operating features in accordance with the inventive arrangements.

Figure 2 is a schematic diagram of recordable DVD media.

Figures 3A-3B, taken together, are a block diagram illustrating a method for configuring a recordable medium to store subsequently added audio-visual data to previously recorded multiplexed audio-visual data.

Figure 4 is a block diagram illustrating an audio-visual dubbing application of the method of the invention.

Figure 5 is a schematic diagram of a recordable medium configured for use in the audio-visual dubbing application illustrated in Figure 4.

Figure 6 is a block diagram illustrating an alternative audio-visual dubbing application of the method of the invention.

Figure 7 is a schematic diagram of a recordable medium configured for use in the alternative audio-visual dubbing application illustrated in Figure 6.

Figure 8 is a block diagram illustrating a convention DVD physical data
structure.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

*Recordable DVD Device*

A device 100 for implementing the DVD-ROM backwards-compatible defect management method in accordance with the inventive arrangements taught herein utilizes a recordable, re-writable disk medium 102 in accordance with the inventive arrangements is shown in block diagram form in Figure 1. The re-writable disk medium 102 is embodied as a re-writable DVD in the illustrated embodiment. In many instances, as will be noted, the re-writable disk medium can also be, for example, a hard drive or a magneto optical disk (MOD). An example of a MOD is a minidisk. In many instances, the inventive arrangements are applicable to video or audio or both video and audio.

The device 100 is capable of writing onto and reading from recordable DVD media, in this example, a re-writable DVD 102. The device comprises a mechanical assembly 104, a control section 120, a video/audio input processing path 140 and a video/audio output processing path 170. The allocation of most of the blocks to different sections or paths is self-evident, whereas the allocation of some of the blocks is made for purposes of convenience and is not critical to understanding the operation of the device.

The mechanical assembly 104 comprises a motor 106 for spinning the disk 102 and a pickup assembly 108 that is adapted to be moved over the spinning disk. The pickup 108 and the motor 106 are controlled by a servo 110. The servo 110 can receive a playback signal of data which can be read from a spiral track of the disk 102 as a first input. The playback signal also can be an input to an error correction circuit 130, which can be considered part of the control section or part of the video/audio output processing path.

When reading data from the disk 102, a laser on the pickup assembly 108 can direct laser light at an interior layer surface of the disk 102. Depending upon the data stored on the disk 102, the laser light can be mostly reflected or mostly absorbed. The pickup assembly 108 can interpret reflected light as one type of electrical signal while light absorbed by the interior layer surface of the disk 102 can be interpreted as a second type of electrical signal. In the preferred
embodiment, transitions between reflectivity and non-reflectivity are mapped to a
digital signal referred to as the playback signal which corresponds to the data
stored on the disk 102.

By comparison, during recording, a laser on the pickup assembly burns
spots onto a spiral track on the disk 102 in order to digitally record video and/or
audio program material. More particularly, the disk 102, which can include at
least one interior crystalline recording layer, can exhibit two distinctive states,
amorphous or crystalline, each having different reflectivity characteristics. Those
different levels of reflectivity can be detected by optical sensors in the pickup
assembly 108.

Prior to recording, the interior recording layer of the disk is in a crystalline
state exhibiting high reflectivity. The light intensity of a laser beam can be
modulated to write amorphous data marks on the surface of tracks in the interior
crystalline recording layer. Specifically, the energy of a laser pulse can quickly
raise the surface temperature of the interior crystalline recording layer above the
layer melting point. Once above the melting point, the interior layer can
transition from a crystalline state of high reflectivity to an amorphous state of
low reflectivity. Subsequently, the rapid cooling of the layer prevents the
molecular structure of the interior layer from reorganizing into a crystalline state.

Hence, digital data can be mapped to a series of laser pulses which can write a
digital code to the disk 102 which can correspond to the digital data.

Notably, depending upon capacity requirements, the disk 102 can have
either one or two recordable sides. Additionally, the disk 102 can have multiple
recordable layers per side. However, for purposes of understanding the
invention, the number of sides and layers is irrelevant. Moreover, in the event of
a double-sided recording, it also is irrelevant whether the recording of both sides
of the disk 102 occurs from one or both sides of the disk 102.

Returning now to Figure 1, the control section 120 preferably comprises a
controller 122 and a navigation data generation circuit 126. The controller 122
supplies a first input signal to the navigation data generation circuit 126 and the
servo 110 supplies a second input signal to the navigation data generation circuit
126. The servo can also be considered part of the control section 120. The
navigation data generation circuit 126 supplies a first input signal to the
multiplexer (MUX) 154, which forms part of the video/audio input processing
path 140. The output of the MUX 154 is an input to an error correction coding
circuit 128. The output of the error correction coding circuit 128 is a recordable
input signal supplied to the pickup 108, which will be "burned" onto the spiral
track of the disk 102 by the laser.

The controller 122 also preferably has access to the data contained in the
track buffer 172 and record buffer 152 as shown in Figure 1. The controller 122
can delete, modify, and reformat video data stored in the track buffer 172 and
record buffer 152 for the purpose of implementing the inventive arrangements.
Control and data interfaces are also preferably provided for permitting the
controller 122 to control the operation of packet video encoder 144 and audio
encoder 148 for implementing the inventive embodiments as described herein.
Suitable software or firmware is provided in memory for the conventional
operations performed by controller 122. In addition, program routines for the
advanced features 134 are provided for controlling the controller 122 in
accordance with the invention as shall hereinafter be described in greater detail.

A control buffer 132 for viewer activatable functions indicates those
functions presently available, namely play, record, reverse, fast forward,
pause/play and stop. The pause is a counterpart to pause operation in a VCR,
for example manually interrupting the play back of a prerecorded program or
interrupting the recording of a viewed program to eliminate commercials from the
recording. A separate pause buffer 136 is provided to receive commands for
performing the pause during record and playback function.

The video/audio input processing path 140 is a signal processing circuit for
converting a conventional television signal, for example NTSC or PAL, into
digitized packet data, for example MPEG-1 or MPEG-2, for digital recording by
the device 100. The input path 140 comprises an NTSC decoder 142 and video
encoder, for example MPEG-1 or MPEG-2, 144 for video in, and comprises an
audio analog-to-digital converter (A/D) 146 and an audio encoder, for example
MPEG-1 or MPEG-2, 148. The digitized signals are combined in a multiplexer
150 and stored in a record buffer 152 until an entire packet has been
constructed. As each packet is constructed, each packet is combined with the output of the navigation data generation circuit in the MUX 154 and sent to the error correction coding circuit 128. Error correction coding circuit 128 can also be deemed to be part of the input path 140.

The output processing path 170 comprises a track buffer, or output buffer, 172, in which data read from the disk is assembled into packets for further processing. The packets are processed by conditional access circuit 174 that controls propagation of the packets through demultiplexer 176 and into respective paths for video and audio processing. The video is decoded by decoder 178, for example from MPEG-1 or MPEG-2, and encoded as a conventional television signal, for example NTSC or PAL. The audio is decoded by circuit 182, for example from MPEG-1 or MPEG-2, and converted to analog form by audio digital-to-analog (D/A) converter 184. The output processing path 170 can be deemed to include the error correction circuit 130, as noted.

Device 100 can represent a machine having, for example, a 1X read and 1X write capability. Such devices can typically have maximum data rates for recording or playing back of approximately 11 megabits/second. In order to implement some of the inventive arrangements is necessary to play back (read) and record (write) in a manner that appears to be simultaneous. It will also be appreciated that the inventive arrangements can also be useful for devices having higher data rates.

**DVD Media**

For purposes of illustrating the inventive arrangements, program material can be recorded onto recordable DVD media, for example the re-writable DVD of Figure 1, and played back from the re-writable DVD. A re-writable DVD 202, as shown in further detail in Figure 2, can consist of two substrates bonded together by an adhesive layer forming a 1.2mm thick disk. A center hole 218 can be formed in the center of the disk so that a gripping device of the motor 106 of Figure 1 can securely grip the disk and control the angular motion of the same in accordance with the inventive arrangements.

As in conventional DVD-RAM technology, the re-writable DVD 202 of the present invention incorporates a land/groove structure and phase change material
to record data to disk. The land/groove combination forms a continuous spiral 212, with data recorded alternately on land and groove. Data can be written onto the re-writable DVD 202 in an outwardly direction along the spiral 212, beginning with the smaller radius portion of the spiral to the larger radius portion of the spiral 212. The several series of three large dots (___) denote portions of the spiral not shown in the drawing. Each nearly circular, radially concentric section of the spiral 212 is sometimes referred to as a track. Notably, the spiral 212 can be formed with a side-to-side wobble, not shown in the drawing, to accommodate media type indexing. Due to difficulties of scale only portions of the spiral 16 are shown, and these are shown in greatly enlarged scale.

To maintain constant data density across the surface of the re-writable DVD 202, the recording surface is divided into twenty-four (24) annular zones. Each zone has 1,888 tracks, including 944 land tracks and 944 groove tracks. Each track is divided into sectors 214 (only a single sector is shown for simplicity). The innermost zone has seventeen (17) sectors per track. The number of sectors per track increases by one in each succeeding zone. Hence, the outermost zone contains forty (40) sectors per track. Each sector 214 begins with a read-only identification field, embossed onto the disk surface. This identification field, known as the header, is used to identify the physical location of the sector and is kept separate from the user recordable data field, to assure that it is permanently readable. The re-writable DVD 202 can further include an embossed area 216 containing read-only data which can identify the type of media, for example DVD-RAM, DVD-ROM, or DVD-R.

It will be appreciated that the advanced features taught herein are applicable to other kinds of disk media and disk media players and recorders. Additionally, various modifications of the device illustrated in Figure 1 and the disk medium illustrated in Figure 2 can be used together to implement the advanced features taught herein in accordance with the inventive arrangements. In particular, a solution for defective sector management in accordance with the inventive arrangements can include modifications of and additions to hardware, firmware and software in the controller 122 for recording data to recordable DVD media.
Recording Multiplexed Material To Facilitate Subsequent Multiplexed Recordings

A method in accordance with the inventive arrangements can include reserving packs in VOBUs during the recording of audio-visual data in the VOBUs. In particular, the reserved packs can be marked with an identifier indicating that the pack is a reserved pack. As a result, during subsequent recording sessions, the reserved packs in the VOBUs can be identified. In consequence, additional audio-visual data and sub-picture data can be added to the already recorded VOBUs by storing the additional audio-visual data and sub-picture data in the reserved packs. Finally, the reserved packs containing the subsequently recorded audio-visual data can be marked according to the type of data contained therein, for example audio, video or sub-picture.

Figures 3A and 3B, taken together, illustrate the process of first reserving a pack in a VOBU during an initial recording session, and subsequently recording audio or sub-picture data into the reserved pack during a subsequent recording session. Still, the invention is not limited in regard to the timing of the subsequent recording session. Rather, in alternative aspects of the invention, the subsequent recording can occur during the same recording session as the initial recording. Specifically, in this alternative embodiment, the initial and subsequent recordings can be part of a single recording process.

Turning now to Figure 3A, video data 301, audio data 302 and sub-picture data 303 can be provided to a multiplexer 310 in which a composite MPEG stream can be produced. Additionally, navigation data 304 can be added to the multiplexed stream. Finally, a reserved pack 305 can be added to the multiplexed stream. The multiplexed composite MPEG stream can be written to a VOBU 320 in the recordable medium. Moreover, the composite MPEG stream can undergo error-correction encoding. Thus, the VOBU 320 can have a navigation pack 325, a video pack 321, an audio pack 322, a sub-picture pack 323 and the reserved pack 324. Notably, as shown in Figures 3A and 3B, packs that are reserved for future editing are designated AR_PCK. Packs having subsequently added data recorded therein are designated VR_PCK.

Turning now to Figure 3B, in a subsequent recording session, a user can
add to the previously recorded VOBU 320, supplemental data, for instance audio data 333 or sub-picture data 335. More particularly, the added supplemental data can be provided to the multiplexer 310 along with navigation data 304 in which a new multiplexed data stream can be produced. Subsequently, the reserved pack 324 of Figure 3A can be identified and the added audio data 333 or sub-picture data 335 can be written thereto. Finally, the reserved pack 324 of Figure 3A can be re-designated an added data pack 326, VR_PCK.

Using pre-reserved packs, such as the reserved pack 324 of Figure 3A, a user can record onto the recordable medium different information at a later time. Such different information can include a song sung by the user, a video clip recorded by the user, or sub-titles generated by the user, while still keeping the original tracks of recorded data intact. Accordingly, the present invention as illustrated in Figures 3A and 3B, can have wide application, including for instance Karaoke, home video and audio dubbing, subtitling and graphics overlays.

Notably, in the present invention, customers can be provided recordable DVDs which contain originally recorded audio-visual material, for instance a music video, in addition to reserved packs. Subsequently, the customer can record supplemental data, for instance video and/or audio of the customer, as well as sub-picture information into the reserved packs. Finally, navigation data can be recorded and associated with the customer recorded data so that a viewer can playback either the original audio-visual data, the customer-added data, or a combination of both. One aspect of this application could include associating one view of a multi-angle view with the customer recorded data. In this way, the viewer can select the precise combination of original and customer-added data for presentation in a DVD player.

Figures 4 and 5 illustrate the application of the present invention to home video and audio dubbing. In particular, Figure 4 illustrates the addition of user-supplied video and audio 402 (and possibly sub-picture data) to a recordable medium 404 having stored thereon previously recorded audio and video (and possibly sub-picture data). In the example of Figure 4, in an initial recording session 403, audio and video data 502 (and possibly sub-picture data) can be recorded to VOBUs in the recordable medium. Significantly, during the initial
recording session, reserved packs can be stored in the VOBU's as well. Specifically, as shown in Figure 5, packs 510 in each VOBU 503 can be reserved for storing supplemental data in a subsequent recording session while the original audio, video and sub-picture data 502 can be stored serially in respective audio, video and sub-picture packs 505. The reserved packs 510 can be designated AR_PCK to indicate that the packs are reserved for future additional audio and video data.

Returning now to Figure 4, following the initial recording 403, during an editing session 405, additional user supplied audio data 408 and video data 406 (and possibly user-supplied sub-picture data) can be added to the recordable medium 404 resulting in a recordable medium 410 containing both the originally recorded audio and video 402 in addition to the added audio and video 406, 408 (and possibly user-added sub-picture data). More particularly, as shown in Figure 5, additional audio and video data 520 (and possibly sub-picture data) can be written to the reserved packs 515 which can be re-designated according to the type of data stored therein --namely sub-picture, audio or video data.

Notably, suitable navigation data can be generated for the additional audio and video data during the editing phase. Consequently, as in the conventional playback of a DVD, the added data can be selectably played back according to user choice. Thus, as shown in Figure 4, in a first arrangement 412 during playback 411 the original video and additional audio can be played back. However, in another arrangement 414, both the original audio and video can be played back. Finally, in a third arrangement 416, the additional video and the original audio can be played back. Still, the invention is not limited to the particular playback arrangements shown and many other playback arrangements are possible.

Notably, the invention further is not limited to the addition of sub-picture, audio and video data to a recordable medium during an editing session. Rather, the additional sub-picture, audio and video can be added to a multiplexed recording in real time during an initial recording session. Figures 6 and 7 illustrate a real-time method for adding additional sub-picture, audio and video data to a multiplexed recording. Specifically, as shown in Figure 6, in a
recording session 603 audio and video data 602 (and possibly sub-picture data) can be recorded to VOBUs in the recordable medium 604. During the recording session 603, reserved packs can be stored in the VOBUs. Specifically, as shown in Figure 7, packs 710 in each VOBU 703 can be reserved for storing additional sub-picture, audio and video data while the original audio, video and sub-picture data 702 can be stored serially in respective audio, video and sub-picture packs 705. Returning now to Figure 6, during the recording session 603, additional user supplied audio data 608 and video data 606 (and possibly sub-picture data) can be added to the recordable media 604 resulting in recordable media 604 containing both the originally recorded audio and video 602 in additional to the added audio and video 606, 608 (and possibly sub-picture data). More particularly, as shown in Figure 7, additional audio and video data 720 (and possibly sub-picture data) can be written to the reserved packs 710 which can be re-designated according to the type of data stored therein --namely sub-picture, audio or video data.

Notably, as in the first example of Figures 4 and 5, suitable navigation data can be generated for the additional data during the editing phase. Consequently, as in the conventional playback of a DVD, the added supplemental data can be selectably played back according to user choice. Thus, as shown in Figure 6, in a first arrangement 612 during playback 611 the original video and additional audio can be played back. However, in another arrangement 614, both the original audio and video can be played back. Finally, in a third arrangement 616, the additional video and the original audio can be played back. Still, the invention is not limited to the particular playback arrangements shown and many other playback arrangements are possible. Moreover, the invention is not limited only to additional video or audio. Rather, the additional data can be additional sub-picture data, as well.

Hence, a method in accordance with the inventive arrangements allows users to customize a re-writable DVD by editing audio-visual data packs in the re-writable DVD. More particularly, during an initial recording session audio-visual packs can be reserved for subsequent recordings. Using the pre-reserved audio-visual packs, a user subsequently can record different information at a later time,
such as a song sung by the user or sub-titles made by the user, while still keeping the original tracks intact.
1. A method for configuring a recordable medium to store subsequently added data to previously recorded multiplexed audio-visual data comprising:
   (a) multiplexing original audio-visual data and navigation data into a composite data stream;
   (b) recording said composite data stream to packs in a recordable medium;
   (c) further recording reserved packs in said recordable medium; and,
   (d) subsequently recording supplemental data corresponding to said original audio-visual data in said reserved packs in said recordable medium.

2. The method of claim 1, wherein said multiplexing step comprises:
   multiplexing said original audio-visual data into an MPEG-compliant data stream;
   multiplexing said navigation data into said MPEG-compliant data stream;
   and,
   error correction encoding said MPEG-compliant data stream.

3. The method of claim 1, further comprising:
   designating said recorded reserved packs as able to accept subsequently recorded supplemental data; and,
   subsequent to recording said supplemental data in said reserved packs, redesignating said reserved packs according to whether said reserved packs contain supplemental sub-picture, audio or video data.

4. The method of claim 1, wherein said recordable medium is a re-writable DVD.

5. The method of claim 4, wherein said recording step comprises recording said composite data stream to packs in a VOBU in said re-writable DVD.
6. The method of claim 1, wherein said steps (a)-(c) occur in an initial recording session and said step (d) occurs in an editing session.

7. The method of claim 1, wherein said steps (a)-(d) occur in a single recording session.

8. A method for configuring a recordable medium to store subsequently added data to previously recorded multiplexed audio-visual data comprising:
   (a) multiplexing original audio and video data into a composite series of data packs in the recordable medium;
   (b) adding reserved packs to said composite series of data packs in the recordable medium; and,
   (c) subsequently writing supplemental data corresponding to said original audio and video data to said reserved packs in said composite series of data packs in the recordable medium;

9. The method of claim 8, further comprising multiplexing navigation data into said composite series of data packs in the recordable medium.

10. The method of claim 8, further comprising:
    designating said reserved packs as able to accept subsequently recorded supplemental data; and,
    subsequent to writing said supplemental data in said reserved packs, re-designating said reserved packs according to whether said reserved packs contain supplemental sub-picture, audio or video data.

11. The method of claim 8, wherein the recordable medium is a re-writable DVD.

12. The method of claim 8, wherein said steps (a)-(b) occur in an initial recording session and said step (c) occurs in an editing session.
13. The method of claim 8, wherein said steps (a)-(c) occur in a single recording session.

14. A recordable medium configured to store subsequently added data to previously recorded multiplexed audio-visual data comprising:
   a plurality of VOBUs, each VOBU having at least one navigation pack and at least one audio-visual data pack for storing original audio-visual data; and,
   at least one reserved pack in at least one of said VOBUs, wherein said reserved pack is selectably designated as able to store subsequently recorded supplemental data corresponding to said original audio-visual data.

15. The recordable medium of claim 14, wherein each audio-visual data pack in said VOBUs is one of an audio pack, a video pack and a sub-picture pack.

16. The recordable medium of claim 14, wherein said original multiplexed audio-visual data is multiplexed in data packs in said VOBUs.

17. A machine readable storage having stored thereon, a computer program having a plurality of code sections for configuring a recordable medium to store subsequently added data to previously recorded multiplexed audio-visual data, said code sections executable by a machine for causing the machine to perform the steps of:
   (a) multiplexing original audio-visual data and navigation data into a composite data stream;
   (b) recording said composite data stream to packs in a recordable medium;
   (c) further recording reserved packs in said recordable medium; and,
   (d) subsequently recording supplemental data corresponding to said original audio-visual data in said reserved packs in said recordable medium.

18. The machine readable storage of claim 17, wherein said multiplexing step comprises:
multiplexing said original audio-visual data into an MPEG-compliant data stream;

multiplexing said navigation data into said MPEG-compliant data stream;

and,

error correction encoding said MPEG-compliant data stream.

19. The machine readable storage of claim 17, further comprising:

designating said recorded reserved packs as able to accept subsequently recorded supplemental data; and,

subsequent to recording said supplemental data in said reserved packs, re-designating said reserved packs according to whether said reserved packs contain supplemental sub-picture, audio or video data.

20. The machine readable storage of claim 17, wherein said recordable medium is a re-writable DVD.

21. The machine readable storage of claim 20, wherein said recording step comprises recording said composite data stream to packs in a VOBU in said re-writable DVD.

22. The machine readable storage of claim 17, wherein said steps (a)-(c) occur in an initial recording session and said step (d) occurs in an editing session.

23. The machine readable storage of claim 17, wherein said steps (a)-(d) occur in a single recording session.

24. A machine readable storage having stored thereon, a computer program having a plurality of code sections for configuring a recordable medium to store subsequently added data to previously recorded multiplexed audio-visual data,

said code sections executable by a machine for causing the machine to perform the steps of:

(a) multiplexing original audio and video data into a composite series of
data packs in the recordable medium;

(b) adding reserved packs to said composite series of data packs in the recordable medium; and,

(c) subsequently writing supplemental data corresponding to said original audio and video data to said reserved packs in said composite series of data packs in the recordable medium;

25. The machine readable storage of claim 24, further comprising multiplexing navigation data into said composite series of packs in the recordable medium.

26. The machine readable storage of claim 24, further comprising:

designating said reserved packs as able to accept subsequently recorded supplemental data; and,

subsequent to writing said supplemental data in said reserved packs, re-designating said reserved packs according to whether said reserved packs contain supplemental sub-picture, audio or video data.

27. The machine readable storage of claim 24, wherein the recordable medium is a re-writable DVD.

28. The machine readable storage of claim 24, wherein said steps (a)-(b) occur in an initial recording session and said step (c) occurs in an editing session.

29. The machine readable storage of claim 24, wherein said steps (a)-(c) occur in a single recording session.
FIG. 1

SUBSTITUTE SHEET (RULE 26)
FIG. 6

FIG. 7

ORIGINAL KARAOKE RESOURCE FROM DVD, TAPE, LD, AND VCD
FIG. 8

SUBSTITUTE SHEET (RULE 26)
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC.

B. FIELDS SEARCHED

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched.

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>WO 99 43000 A (ANDO HIDEO; YOSHIoka YOU (JP); TOKYO SHIBAURA ELECTRIC CO (JP)) 26 August 1999 (1999-08-26) abstract &amp; EP 1 065 665 A: pub1.03-01-2001 page 10, paragraph 110-page 12, paragraph 146; figure 5-7; page 26, paragraph 363-page 27, paragraph 375</td>
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Further documents are listed in the continuation box C.

Patent family members are listed in annex.

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Date of the actual completion of the international search: 19 April 2001

Date of mailing of the international search report: 26/04/2001

Name and mailing address of the ISA

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Fax: (+31-70) 340-3016

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