US 20120301118A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2012/0301118 A1**

(43) **Pub. Date: Nov. 29, 2012**

Ju

(54) **OPTICAL DISC PLAYER SYSTEM AND METHOD OF CONTROLLING A DECODING UNIT IN THE OPTICAL DISC PLAYER SYSTEM TO READ ENCODED BITSTREAM DATA FROM A BUFFER MEMORY**

(76) Inventor: **Shang-Tzu Ju**, Hsinchu City (TW)

(21) Appl. No.: **13/562,333**

(22) Filed: **Jul. 31, 2012**

Related U.S. Application Data

(63) Continuation of application No. 12/471,408, filed on May 25, 2009, now Pat. No. 8,254,765, which is a continuation of application No. 11/279,253, filed on Apr. 11, 2006, now Pat. No. 7,555,201, which is a continuation-in-part of application No. 10/376,443, filed on Feb. 28, 2003, now abandoned.

(30) **Foreign Application Priority Data**

Mar. 1, 2002 (TW) 091103814

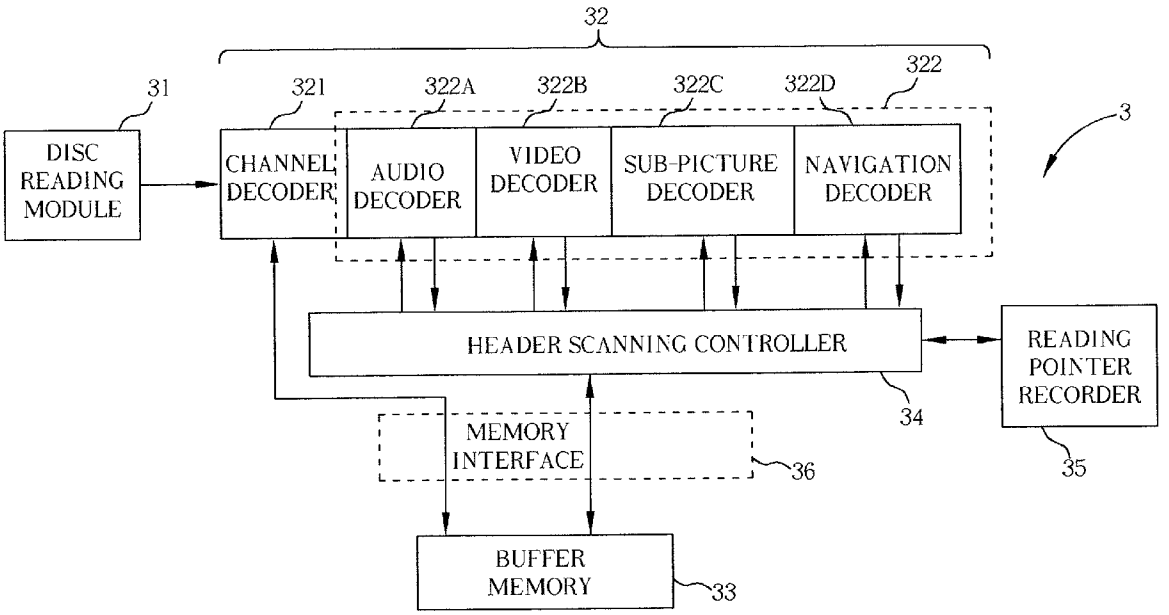
Publication Classification

(51) **Int. Cl.**
H04N 5/917 (2006.01)

(52) **U.S. Cl.** **386/326**; 386/E05.064

(57) **ABSTRACT**

A data processing apparatus for decoding a bitstream includes a channel decoder, a demultiplexer and a plurality of decoders. The channel decoder is used for generating an encoded bitstream data from a received channel data and storing the encoded bitstream data to a buffer, wherein the encoded bitstream contains a plurality types of sectors. The demultiplexer is used for rearranging the stored encoded bitstream data according to the plurality of types and storing sectors corresponding to the same bitstream type in respective regions in the buffer. The decoders are used for decoding the sectors corresponding to the bitstream types, the decoders retrieving the rearranged data from the buffer according to corresponding one of the plurality of types.



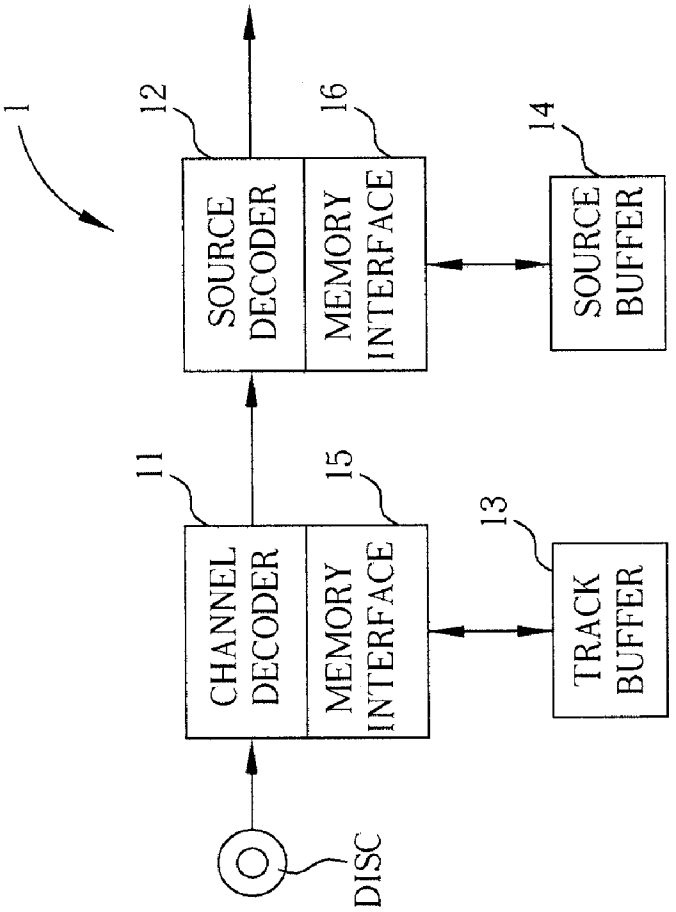


Fig. 1 Prior Art

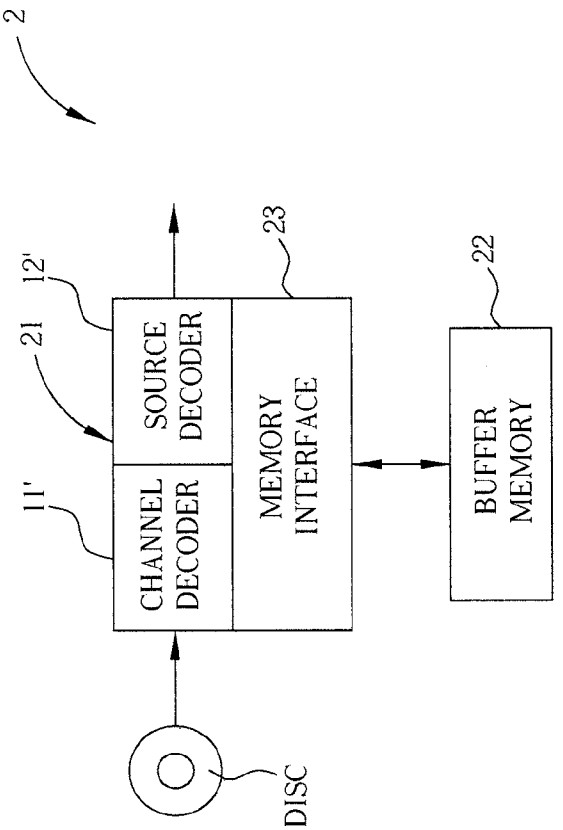


Fig. 2 Prior Art

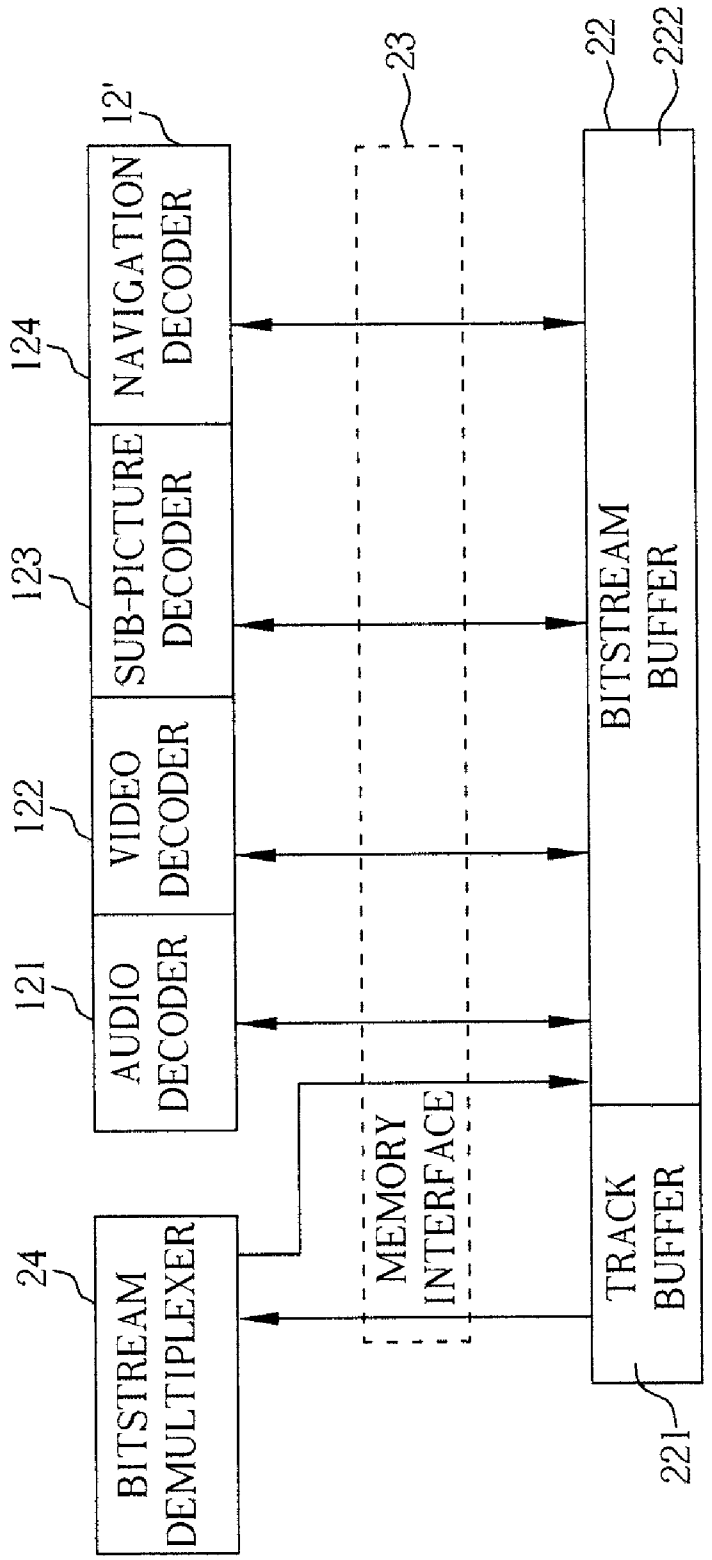


Fig. 3 Prior Art

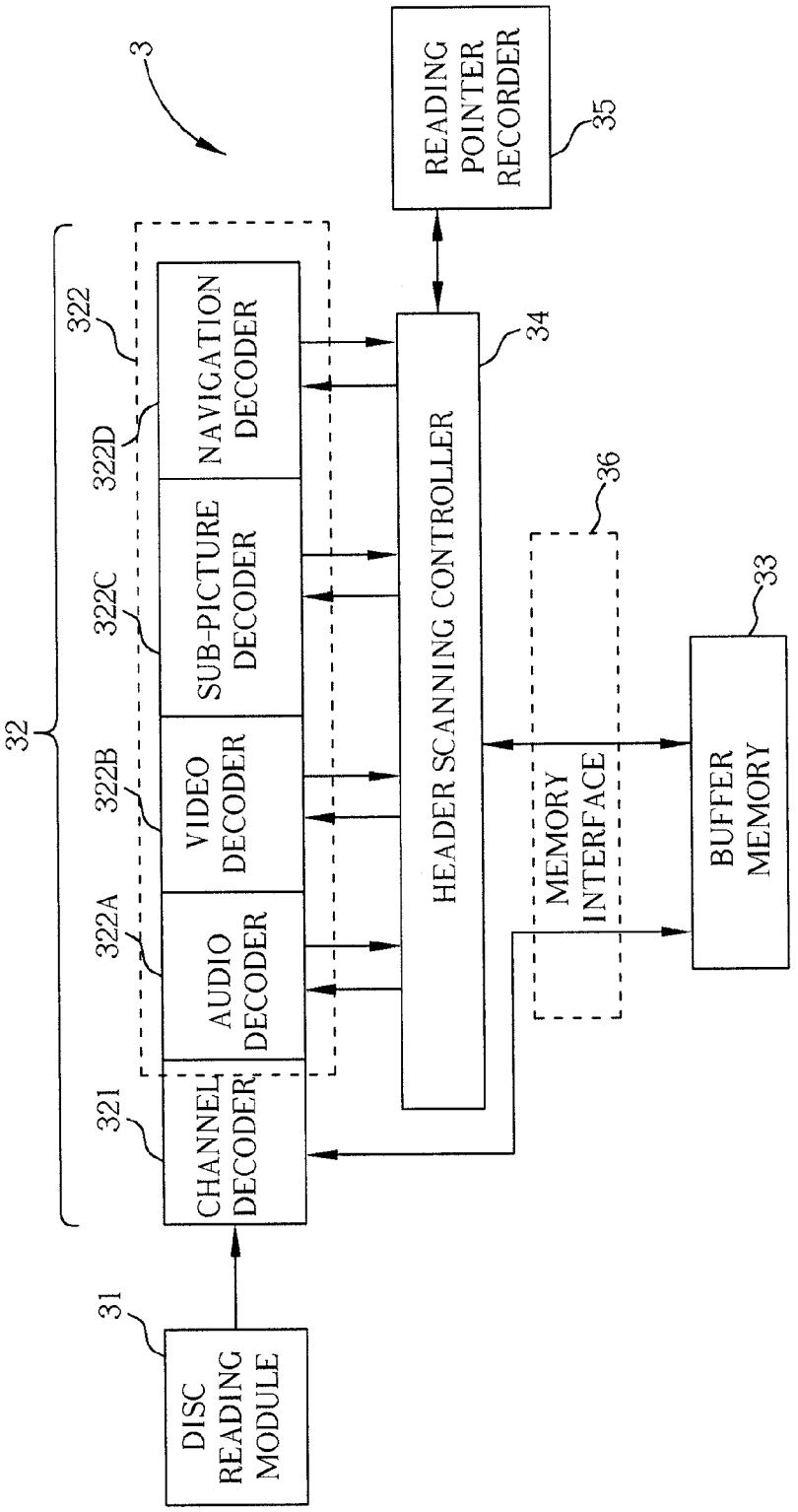

3
READING POINTER RECORDER
35
32
322
322D
322C
322B
322A
321
NAVIGATION DECODER
SUB-PICTURE DECODER
VIDEO DECODER
AUDIO DECODER
CHANNEL DECODER
34
HEADER SCANNING CONTROLLER
36
MEMORY INTERFACE
33
BUFFER MEMORY
31
DISC READING MODULE

Fig. 4

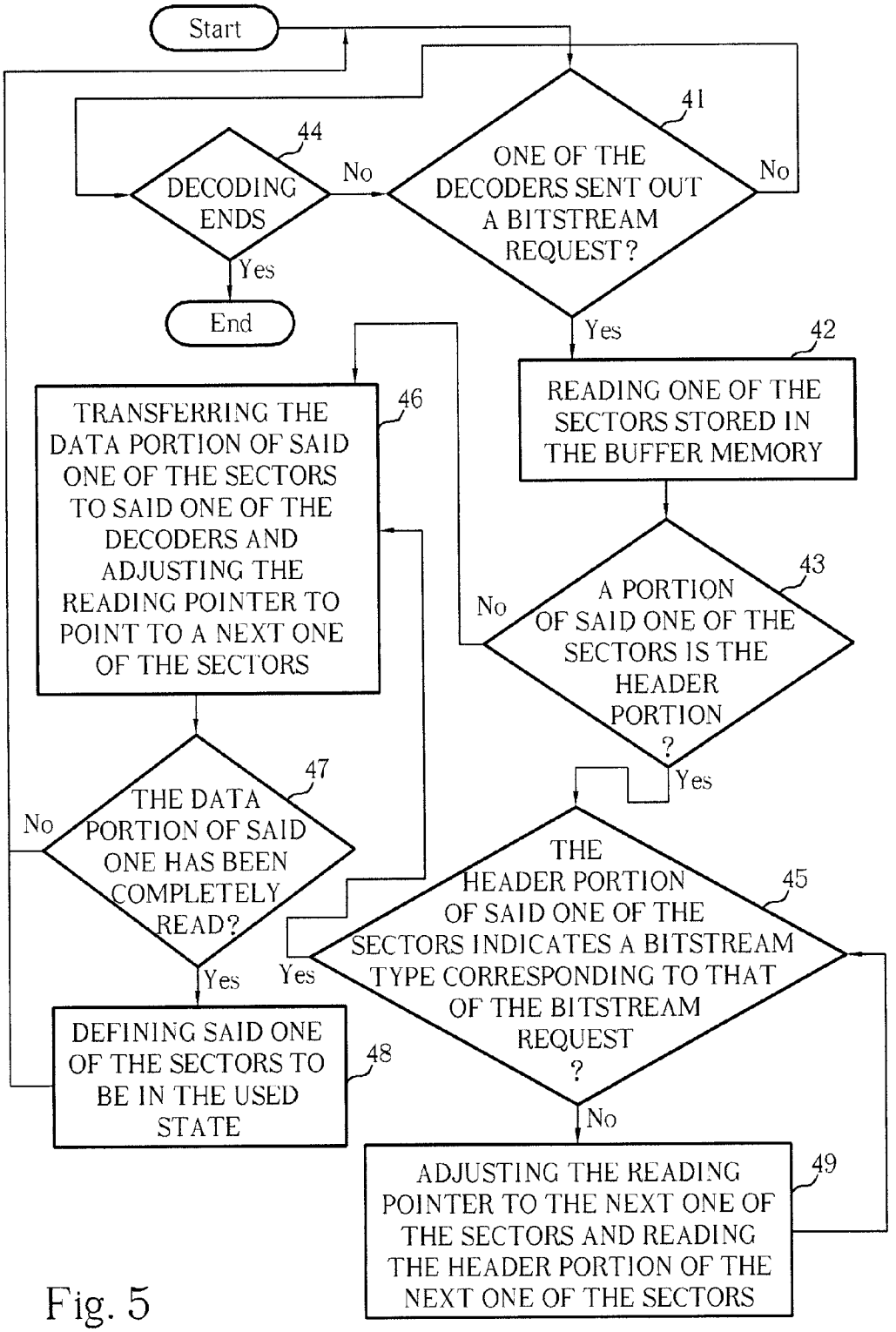

Start
41
ONE OF THE DECODERS SENT OUT A BITSTREAM REQUEST?
No
44
DECODING ENDS
No
Yes
End
Yes
42
READING ONE OF THE SECTORS STORED IN THE BUFFER MEMORY
43
A PORTION OF SAID ONE OF THE SECTORS IS THE HEADER PORTION ?
No
Yes
46
TRANSFERRING THE DATA PORTION OF SAID ONE OF THE SECTORS TO SAID ONE OF THE DECODERS AND ADJUSTING THE READING POINTER TO POINT TO A NEXT ONE OF THE SECTORS
47
THE DATA PORTION OF SAID ONE HAS BEEN COMPLETELY READ?
No
Yes
45
THE HEADER PORTION OF SAID ONE OF THE SECTORS INDICATES A BITSTREAM TYPE CORRESPONDING TO THAT OF THE BITSTREAM REQUEST ?
Yes
No
48
DEFINING SAID ONE OF THE SECTORS TO BE IN THE USED STATE
49
ADJUSTING THE READING POINTER TO THE NEXT ONE OF THE SECTORS AND READING THE HEADER PORTION OF THE NEXT ONE OF THE SECTORS

Fig. 5

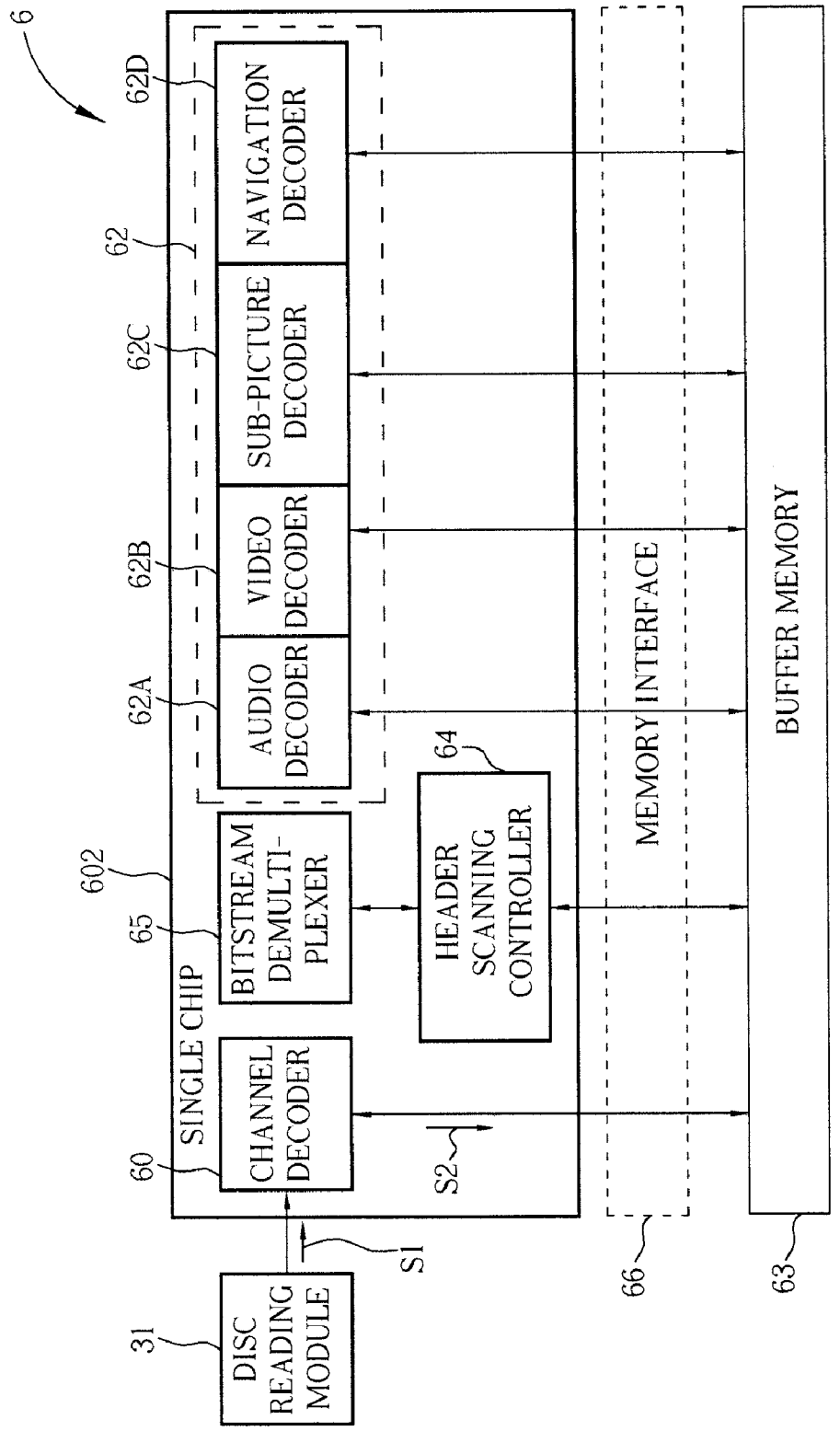

6
62D
NAVIGATION DECODER
62
62C
SUB-PICTURE DECODER
62B
VIDEO DECODER
62A
AUDIO DECODER
602
SINGLE CHIP
65
BITSTREAM DEMULTI-PLEXER
64
HEADER SCANNING CONTROLLER
60
CHANNEL DECODER
S2
S1
31
DISC READING MODULE
MEMORY INTERFACE
66
BUFFER MEMORY
63

Fig. 6

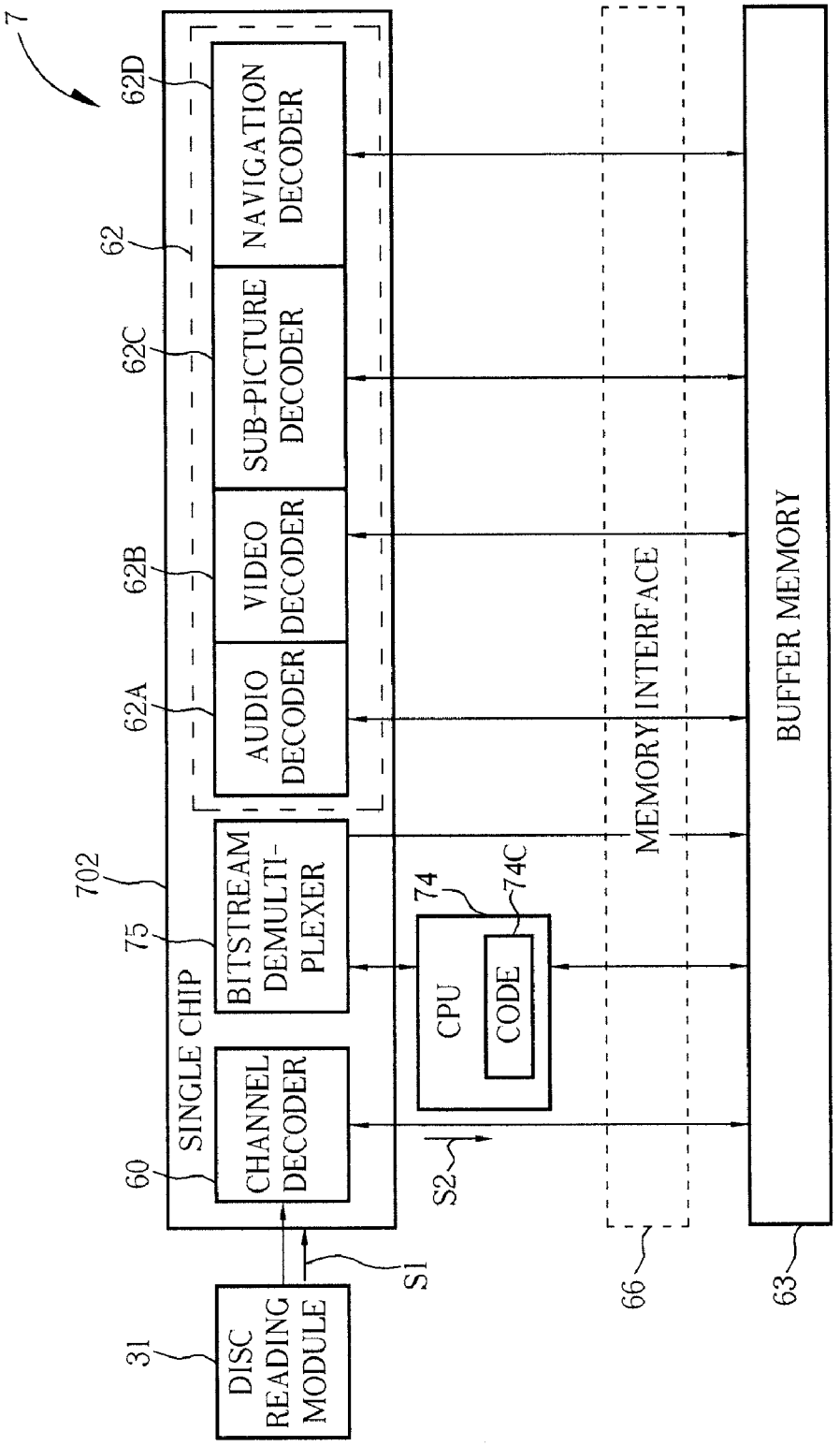

7
62D
NAVIGATION DECODER
62
62C
SUB-PICTURE DECODER
62B
VIDEO DECODER
62A
AUDIO DECODER
702
75
BITSTREAM DEMULTI-PLEXER
74
74C
CPU
CODE
SINGLE CHIP
60
CHANNEL DECODER
S2
S1
31
DISC READING MODULE
MEMORY INTERFACE
66
BUFFER MEMORY
63

Fig. 7

OPTICAL DISC PLAYER SYSTEM AND METHOD OF CONTROLLING A DECODING UNIT IN THE OPTICAL DISC PLAYER SYSTEM TO READ ENCODED BITSTREAM DATA FROM A BUFFER MEMORY

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of the co-pending U.S. application Ser. No. 12/471,408, which is a continuation of U.S. application Ser. No. 11/279,253 (which is a continuation-in-part of U.S. application Ser. No. 10/376,443 (expressly abandoned during examination)). The entire contents of these related applications are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The invention relates to optical disc player systems and a method for controlling a decoding unit to read data from a memory device, more particularly to an optical disc player system and a method of controlling a decoding unit in the optical disc player system to read encoded bitstream data from a buffer memory, and an optical disc player system capable of saving the memory bandwidth between a bitstream demultiplexer and a memory.

[0004] 2. Description of the Prior Art

[0005] FIG. **1** illustrates a conventional DVD player system **1** that includes a channel decoder **11** for reading and error-correcting the encoded bitstream data from a disc, a track buffer **13** connected to the channel decoder **11** via a memory interface **15** for storing error-corrected bitstream data from the channel decoder **11**, a source decoder **12** connected to the channel decoder **11** for decoding the bitstream data from the channel decoder **11**, and a source buffer **14** connected to the source decoder **12** via a memory interface **16** for storing decoded video and audio data from the source decoder **12**. In an actual design, the channel decoder **11** and the source decoder **12** are implemented using two separate chips, thereby resulting in a relatively high cost. In order to reduce costs, there is provided a combined chip integrated with the aforesaid functions of the channel and source decoders.

[0006] FIG. **2** illustrates another DVD player system **2** that includes a decoding unit **21** having a channel decoder **11'** and a source decoder **12'**. The integrated decoding unit **21** performs functions the same as those in the system of FIG. **1**, and a combined buffer memory **22** connected to the decoding unit **21** via a memory interface **23**. Referring to FIG. **3**, the buffer memory **22** includes a track buffer **221** for storing data from a disc, and a bitstream buffer **222** for storing demultiplexed bitstream data processed by a bitstream demultiplexer **24** and decoded video and audio data for playback. The decoding unit **12'** includes an audio decoder **121**, a video decoder **122**, a sub-picture decoder **123** and a navigation decoder **124**. During a decoding procedure, the bitstream demultiplexer **24** reads encoded bitstream data from the track buffer **221** of the buffer memory **221** via the memory interface **23**. After error-correcting and demultiplexing of the encoded bitstream data, the demultiplexed bitstream data is transferred to the bitstream buffer **222** of the buffer memory **22** via the memory interface **23**. The decoders **121**, **122**, **123**, **124** read the demultiplexed bitstream data stored in the bitstream buffer **222** of the buffer memory **22** for decoding via the memory interface **23**. As such, the buffer memory **22** in the conventional system **2** of FIG. **2** must provide a large bandwidth for channel decoding and source decoding, thereby resulting in relatively high costs and power consumption.

SUMMARY OF THE INVENTION

[0007] Therefore, an object of the present invention is to provide an optical disc player system and a method of controlling a decoding unit in the optical disc player system to read encoded bitstream data from a buffer memory that can reduce the memory bandwidth requirement so as to result in relatively low costs and power consumption. Another object of the present invention is to provide an optical disc player system capable of saving the memory bandwidth between a bitstream demultiplexer and a memory.

[0008] According to a first aspect of the present invention, a data processing apparatus for decoding a bitstream is disclosed. The data processing apparatus includes a channel decoder, a demultiplexer and a plurality of decoders. The channel decoder is used for generating an encoded bitstream data from a received channel data and storing the encoded bitstream data to a buffer, wherein the encoded bitstream contains a plurality types of sectors. The demultiplexer is used for rearranging the stored encoded bitstream data according to the plurality of types and storing sectors corresponding to the same bitstream type in respective regions in the buffer. The decoders are used for decoding the sectors corresponding to the bitstream types, the decoders retrieving the rearranged data from the buffer according to corresponding one of the plurality of types.

[0009] According to a second aspect of the present invention, a method for decoding a bitstream has the following steps: (a) generating an encoded bitstream data from a received channel data and storing the encoded bitstream data to a buffer, wherein the encoded bitstream contains a plurality types of sectors; (b) rearranging the stored encoded bitstream data according to the plurality of types and storing sectors corresponding to the same bitstream type in respective regions in the buffer; (c) retrieving the rearranged data from the buffer according to corresponding one of the plurality of types; and (d) decoding the sectors corresponding to the bitstream types by a plurality of decoders.

[0010] These and other objectives of the present invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various figures and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Other features and advantages of the present invention will become apparent in the following detailed description of the preferred embodiment and the variations thereof with reference to the accompanying drawings, of which:

[0012] FIG. **1** is a schematic circuit block diagram of a conventional DVD player system;

[0013] FIG. **2** is a schematic circuit block diagram of another conventional DVD player system;

[0014] FIG. **3** is a schematic circuit block diagram illustrating a bitstream demultiplexing operation in the conventional DVD player system of FIG. **2**;

[0015] FIG. **4** is a schematic circuit block diagram illustrating the preferred embodiment of an optical disc player system according to the present invention;

[0016] FIG. **5** is a flow chart illustrating a method of controlling a decoding unit in the preferred embodiment to read encoded bitstream data from a buffer memory;

[0017] FIG. **6** is a schematic circuit block diagram of an optical disc player system according to another embodiment of the present invention; and

[0018] FIG. **7** is a schematic circuit block diagram of an optical disc player system according to another embodiment of the present invention.

DETAILED DESCRIPTION

[0019] Referring to FIG. **4**, the preferred embodiment of an optical disc player system **3**, such as a DVD player, according to the present invention is shown to include a buffer memory **33**, a header scanning controller **34**, a decoding unit **32**, and a reading pointer recorder **35**.

[0020] The buffer memory **33**, such as a track buffer, stores encoded bitstream data that is read by a disc reading module **31** from an optical disc (not shown) and that is error-corrected by a channel decoder **30**. The encoded bitstream data is divided into a plurality of sectors, each of which includes a data portion, and a header portion for indicating a bitstream type of the data portion. The header portion includes a sector ID, a pack header and a packet header.

[0021] The header scanning controller **34** is connected to the buffer memory **33** via a memory interface **36**.

[0022] The decoding unit **32** is connected to the header scanning controller **34**, and includes a channel decoder **321** and a set of different data decoders **322** including audio decoder **322**A, video decoder **322**B, sub-picture decoder **322**C, and navigation decoder **322**D. Each of the data decoder is used to decode data with a specific bitstream type. Each of the data decoders **322**A, **322**B, **322**C, **322**D is capable of sending a bitstream request for reading encoded bitstream data stored in the buffer memory **33** via the header scanning controller **34**. In this embodiment, the decoding unit **32** includes an audio decoder **322**A for decoding audio data, a video decoder **322**B for decoding video data, a sub-picture decoder **322**C, and a navigation decoder **322**D.

[0023] The reading pointer recorder **35** is connected to the header scanning controller **34** and stores four reading pointers associated with the data decoders **322**A, **322**B, **322**C, and **322**D. The four reading pointers are audio reading pointer, video reading pointer, sub-picture reading pointer, and navigation reading pointer respectively.

[0024] The header scanning controller **34** reads one of the sectors stored in the buffer memory **33** according to the reading pointer from the reading pointer recorder **35** that is associated with one of the decoders **322**A, **322**B, **322**C, **322**D that sent out the bitstream request when the header scanning controller **34** receives the bitstream request from said one of the data decoders **322**A, **3228**, **322**C, **322**D.

[0025] The header scanning controller **34** transfers the data portion of said one of the sectors that is being read from the buffer memory **33** to the data decoder (**322**A, **322**B, **322**C, or **322**D) that sent out the bitstream request when the header portion of said one of the sectors that is being read from the buffer memory **33** indicates a bitstream type corresponding to that of the bitstream request, and the header scanning controller **34** also enables the reading pointer recorder **35** to adjust the reading pointer to point to a next one of the sectors stored in the buffer memory **33** after reading of said one of the sectors has been completed.

[0026] Furthermore, the header scanning controller **34** enables the reading pointer recorder **35** to adjust the reading pointer associated with said one of the decoders **322**A, **322**B, **322**C, **322**D that sent out the bitstream request to point to a next one of the sectors stored in the buffer memory **33**, and reads the header portion of the next one of the sectors when the bitstream type indicated by the header portion of said one of the sectors being read from the buffer memory **33** does not correspond to that of the bitstream request.

[0027] For example, when the video decoder **322**B sends out a bitstream request for video data, the header scanning controller **34** receives the bitstream request, reads the sector which is a video bitstream type (a video sector) according to the video reading pointer of the reading pointer recorder **35**. After the current video sector has been read from the buffer memory **33**, the header scanning controller **34** enables the reading pointer recorder **35** to move the video reading pointer to a next video sector in the buffer memory **33**. The similar procedure also applies to the audio decoder **322**A, the sub-picture decoder **322**C, and the navigation decoder **322**D.

[0028] It is noted that each of the sectors stored in the buffer memory **33** is defined by the header scanning controller **34** to be in a used state when the data portion thereof has been completely read, and to be in an unused state when otherwise. The header scanning controller **34** enables the reading pointer recorder **35** to adjust the four reading pointers to point the next audio sector, next video sector, next sub-picture sector, or next navigation sector in the buffer memory **33** that is in the unused state when the bitstream type indicated by the header portion of said one of the sectors being read from the buffer memory **33** does not correspond to that of the current bitstream request.

[0029] Referring to FIG. **5**, there is shown a flow chart to illustrate how the header scanning controller **34** controls the decoding unit **32** in the optical disc player system **3** of the preferred embodiment to read the bitstream data from the buffer memory **33**. In step **41**, the header scanning controller **34** determines whether one of the decoders **322**A, **322**B, **322**C, **322**D sends out the bitstream request. For example, the header scanning controller **34** detects that the audio decoder **321** sends out the bitstream request for decoding audio data. In step **42**, the header scanning controller **34** reads one of the sectors stored in the buffer memory **33** according to a reading pointer that is associated with said one of the decoders **322**A, **322**B, **322**C, **322**D that sends out the bitstream request (for example, the audio decoder **322**A). In step **43**, the header scanning controller **34** determines whether a portion of said one of the sectors being read from the buffer memory **33** is the header portion. In step **45**, when the portion of said one of the sectors is the header portion, the header scanning controller **34** determines whether the header portion of said one of the sectors that is being read from the buffer memory **33** indicates a bitstream type corresponding to that of the bitstream request. In step **46**, the header scanning controller **34** transfers the data portion of said one of the sectors that is being read from the buffer memory **33** to said one of the decoders **322**A, **322**B, **322**C, **322**D that sends out the bitstream request (for example, the audio decoder **322**A) upon determining in step **45** that the bitstream type indicated by the header portion of said one of the sectors corresponds to that of the bitstream request, and enables the reading pointer recorder **35** to adjust the reading pointer to point to a next one of the sectors stored in the buffer memory **33** after reading of said one of the sectors has been completed. It is noted that, in this case, the

reading pointer recorder **35** adjusts the reading pointer to point to the next one of the sectors stored in the buffer memory **33** that is in the unused state. Furthermore, when it is determined in step **43** that the portion of said one of the sectors being read from the buffer memory **33** is not the header portion, the flow proceeds to step **46**. In step **47**, the header scanning controller **34** determines whether the data portion of said one of the sectors that is being read from the buffer memory **33** has been read completely. When the data portion of said one of the sectors that is being read from the buffer memory **33** has yet to be read completely, the flow proceeds back to step **41**. In step **48**, the header scanning controller **34** defines said one of the sectors to be in the used state when the data portion of said one of the sectors that is being read from the buffer memory **33** has been read completely, and the flow proceeds back to step **41**. In step **49**, the header scanning controller **34** enables the reading pointer recorder **35** to adjust the reading pointer associated with said one of the decoders **322**A, **322**B, **322**C, **322**D (for example, the audio decoder **322**A) that sends out the bitstream request to point to the next one of the sectors stored in the buffer memory **33**, and reads the header portion of the next one of the sectors when the bitstream type indicated by the header portion of said one of the sectors being read from the buffer memory **13** is determined in step **45** as not corresponding to that of the bitstream request. The flow then proceeds back to step **45**. It is noted that, in this case, the reading pointer recorder **35** adjusts the reading pointer to point to the next one of the sectors stored in the buffer memory **33** that is in the unused state. In step **44**, when none of the decoders **321**, **322**, **323**, **324** sent out a bitstream request, the header scanning controller **34** determines whether decoding of the decoding unit **32** ends. If no, the flow proceeds back to step **41**.

[0030] Accordingly, in the optical disc player system **3** of the present invention, the header scanning controller **34** can control the decoding unit **32** to read encoded bitstream data from the buffer memory **33** through the memory interface **36** such that the buffer memory **33** has a relatively low memory bandwidth requirement, thereby resulting in relatively low costs and power consumption. An object of the invention is thus met.

[0031] FIG. **6** is a schematic circuit block diagram of an optical disc player system **6** according to another embodiment of the present invention. The optical disc player system **6** includes the disc reading module **31** mentioned above. The optical disc player system **6** further includes a channel decoder **60** for generating encoded bitstream data S**2** according to an optical disc readout signal S**1** generated by the disc reading module **31**. In this embodiment, the channel decoder **60** is a composite module **60** including the following components (not shown): a DVD/CD digital signal processor (DSP) for decoding the optical disc readout signal S**1**; a DVD/CD servo controller for performing servo control while the optical disc player system **4** accessing the optical disc; and a DVD/CD error correction code (ECC) decoder for performing ECC correction to generate the encoded bitstream data S**2**.

[0032] As shown in FIG. **6**, the optical disc player system **6** further includes a buffer memory **63** for storing the encoded bitstream data S**2**. The encoded bitstream data is divided into a plurality of sectors, each of which includes a data portion, and a header portion for indicating a bitstream type of the data portion. Wherein, the header portion includes a sector ID, a pack header and a packet header. The optical disc player system **6** further includes: a memory interface **66**; a header scanning controller **64** coupled to the buffer memory **63** via the memory interface **66** for scanning the header portion and accessing the encoded bitstream data stored in the buffer memory **63**; and a bitstream demultiplexer **65** coupled to the header scanning controller **64** for rearranging the encoded bitstream data stored in the buffer memory **63** according to the bitstream type for continuously storing sectors corresponding to the same bitstream type in the same region within the buffer memory **63**.

[0033] Please note, the header scanning controller **64** of this embodiment is a simplified variation of the header scanning controller **34** shown in FIG. **4** since the header scanning controller **64** does not need an additional component such as the reading pointer recorder **35** shown in FIG. **4** while the bitstream demultiplexer **65** is rearranging the encoded bitstream data stored in the buffer memory **63**. As the header scanning controller **64** is capable of scanning the header portion to determine the bitstream type of the corresponding data portion, the bitstream demultiplexer **65** does not need to read a data portion of an unwanted bitstream type. The bitstream demultiplexer **65** simply reads data of a specific bitstream type and continuously store the data of the specific bitstream type in a specific region within the buffer memory **63**. As a result, the memory bandwidth between the bitstream demultiplexer **65** and the buffer memory **63** is saved.

[0034] The optical disc player system **6** further includes a decoding unit **62** coupled to the buffer memory **63**. In this embodiment, the decoding unit **62** is a MPEG decoding unit **62** including an audio decoder **62**A for decoding audio data, a video decoder **62**B for decoding video data, a sub-picture decoder **62**C, and a navigation decoder **62**D. Each of the decoders **62**A, **62**B, **62**C, and **62**D is used to decode data with a specific bitstream type and is capable of reading encoded bitstream data stored in the buffer memory **63** by direct memory access (DMA). Please note, the channel decoder **60**, the decoding unit **62**, the bitstream demultiplexer **65**, and the header scanning controller **64** are integrated into a single chip **602**.

[0035] FIG. **7** is a schematic circuit block diagram of an optical disc player system **7** according to another embodiment of the present invention. The embodiment shown in FIG. **7** is similar to the embodiment shown in FIG. **6** with exceptions described as follows. As shown in FIG. **7**, the header scanning controller **74** of this embodiment is a Central Processing Unit (CPU) **74** executing a specific program code **74***c*, and the channel decoder **60**, the decoding unit **62**, and the bitstream demultiplexer **75** are integrated into a single chip **702**.

[0036] While the present invention has been described in connection with what is considered the most practical and preferred embodiment, it is understood that this invention is not limited to the disclosed embodiments but is intended to cover various arrangements included within the spirit and scope of the broadest interpretation so as to encompass all such modifications and equivalent arrangements.

[0037] Those skilled in the art will readily observe that numerous modifications and alterations of the device and method may be made while retaining the teachings of the invention. Accordingly, the above disclosure should be construed as limited only by the metes and bounds of the appended claims.

What is claimed is:

1. A data processing apparatus for decoding a bitstream, comprising:

a channel decoder for generating an encoded bitstream data from a received channel data and storing the encoded bitstream data to a buffer, wherein the encoded bitstream contains a plurality types of sectors;

a demultiplexer for rearranging the stored encoded bitstream data according to the plurality of types and storing sectors corresponding to the same bitstream type in respective regions in the buffer; and

a plurality of decoders for decoding the sectors corresponding to the bitstream types, the decoders retrieving the rearranged data from the buffer according to corresponding one of the plurality of types.

2. The data processing apparatus as claimed in claim **1**, wherein the data processing apparatus is a integrated single chip.

3. The data processing apparatus as claimed in claim **1**, wherein the decoders retrieving the rearranged data from the buffer by direct memory access (DMA).

4. The data processing apparatus as claimed in claim **1**, wherein the channel decoder corrects error of the received channel data so as to generate the encoded bitstream data.

5. A method for decoding a bitstream, comprising the following steps:

(a) generating an encoded bitstream data from a received channel data and storing the encoded bitstream data to a buffer, wherein the encoded bitstream contains a plurality types of sectors;

(b) rearranging the stored encoded bitstream data according to the plurality of types and storing sectors corresponding to the same bitstream type in respective regions in the buffer;

(c) retrieving the rearranged data from the buffer according to corresponding one of the plurality of types; and

(d) decoding the sectors corresponding to the bitstream types by a plurality of decoders.

6. The method as claimed in claim **5**, wherein the step (c) further comprises: retrieving the rearranged data from the buffer by direct memory access (DMA).

7. The method as claimed in claim **5**, wherein the step (a) further comprises: generating the encoded bitstream data by correcting error of the received channel data.

* * * * *