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Watson et al.

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(54) **SYSTEM AND METHOD FOR AUTOMATICALLY CREATING A MEDIA ARCHIVE FROM CONTENT ON A RECORDING MEDIUM**

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CPC ***H04N 5/76*** (2013.01); ***G11B 20/1883*** (2013.01); ***H04N 5/781*** (2013.01); ***H04N 5/85*** (2013.01);
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(Continued)

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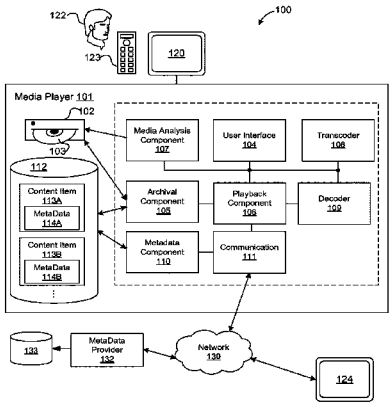
(57) **ABSTRACT**

A media player may include a media reader to read media content from a recording medium inserted into the media reader. The media player may also include a media analysis component to identify one or more valid portions of the recording medium containing media content and one or more invalid portions of the recording medium without media content. In one embodiment, the media player includes an archival component to store the media content from the one or more valid portions in a storage medium and a playback component to play back the one or more valid portions of the media content from the storage medium concurrently with the identification of the one or more valid
(Continued)



portions by the media analysis component and the storage of the media content by the archival component.

20 Claims, 8 Drawing Sheets

Related U.S. Application Data

continuation of application No. 12/332,121, filed on Dec. 10, 2008, now Pat. No. 8,582,954.

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H04N 5/76	(2006.01)
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H04N 5/781	(2006.01)
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H04N 5/907	(2006.01)
H04N 9/87	(2006.01)
H04N 5/94	(2006.01)
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H04N 5/765	(2006.01)
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USPC 386/270; 369/53.15, 53.17; 707/999.004, 999.2; 720/600

See application file for complete search history.

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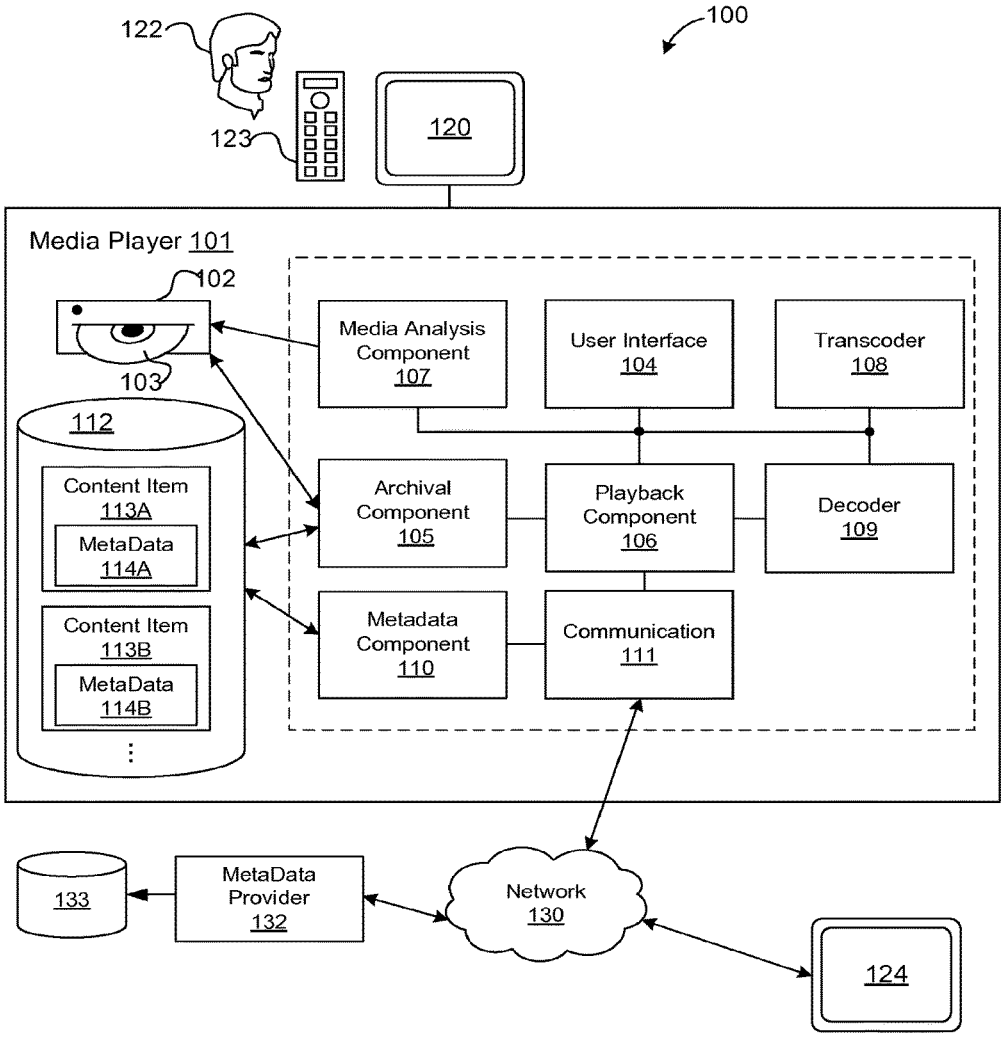
100
122
123
120
Media Player 101
102
103
112
Content Item 113A
MetaData 114A
Content Item 113B
MetaData 114B
Media Analysis Component 107
User Interface 104
Transcoder 108
Archival Component 105
Playback Component 106
Decoder 109
Metadata Component 110
Communication 111
133
MetaData Provider 132
Network 130
124

FIG. 1

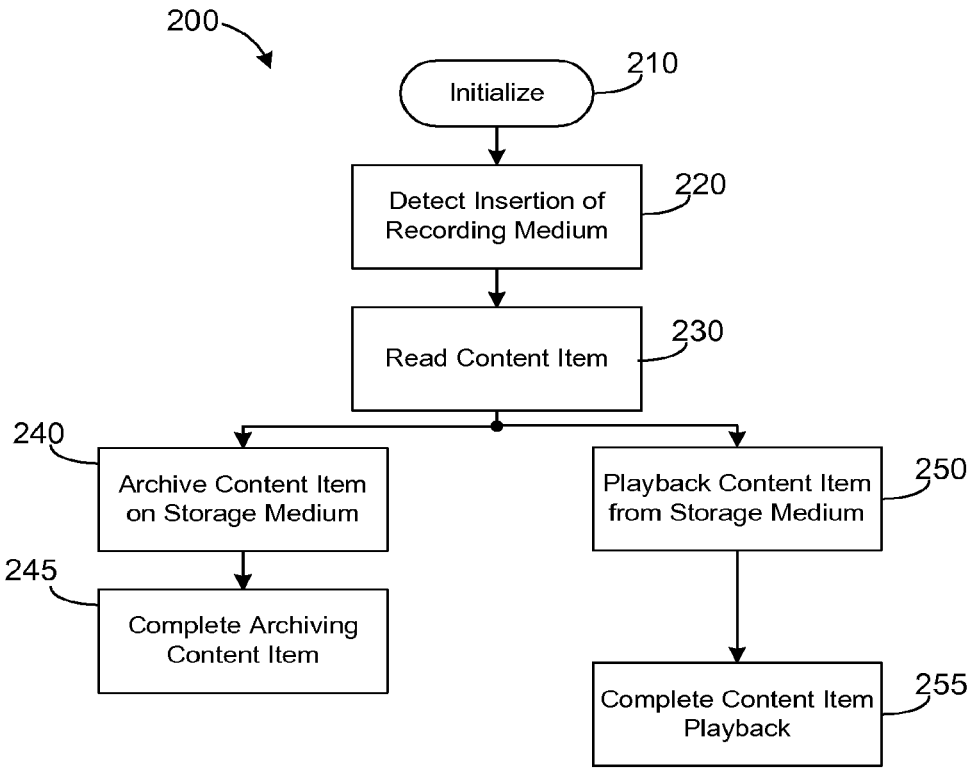
200
Initialize
210
Detect Insertion of Recording Medium
220
Read Content Item
230
240
Archive Content Item on Storage Medium
245
Complete Archiving Content Item
Playback Content Item from Storage Medium
250
Complete Content Item Playback
255

FIG. 2A

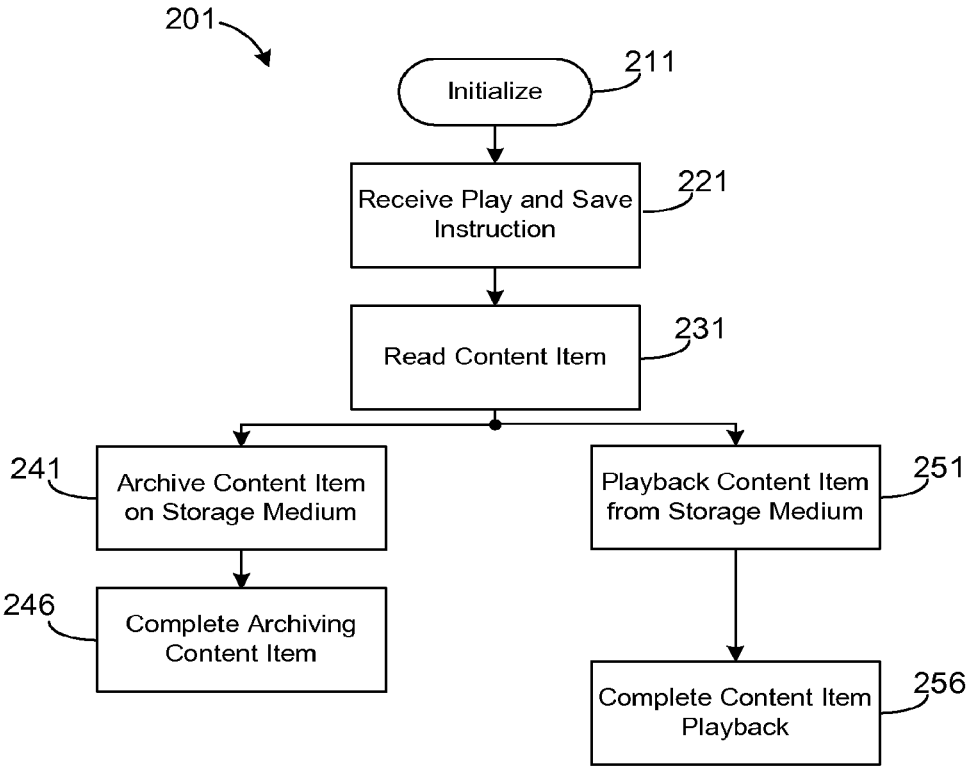
201
Initialize
211
Receive Play and Save Instruction
221
Read Content Item
231
241
Archive Content Item on Storage Medium
246
Complete Archiving Content Item
Playback Content Item from Storage Medium
251
Complete Content Item Playback
256

FIG. 2B

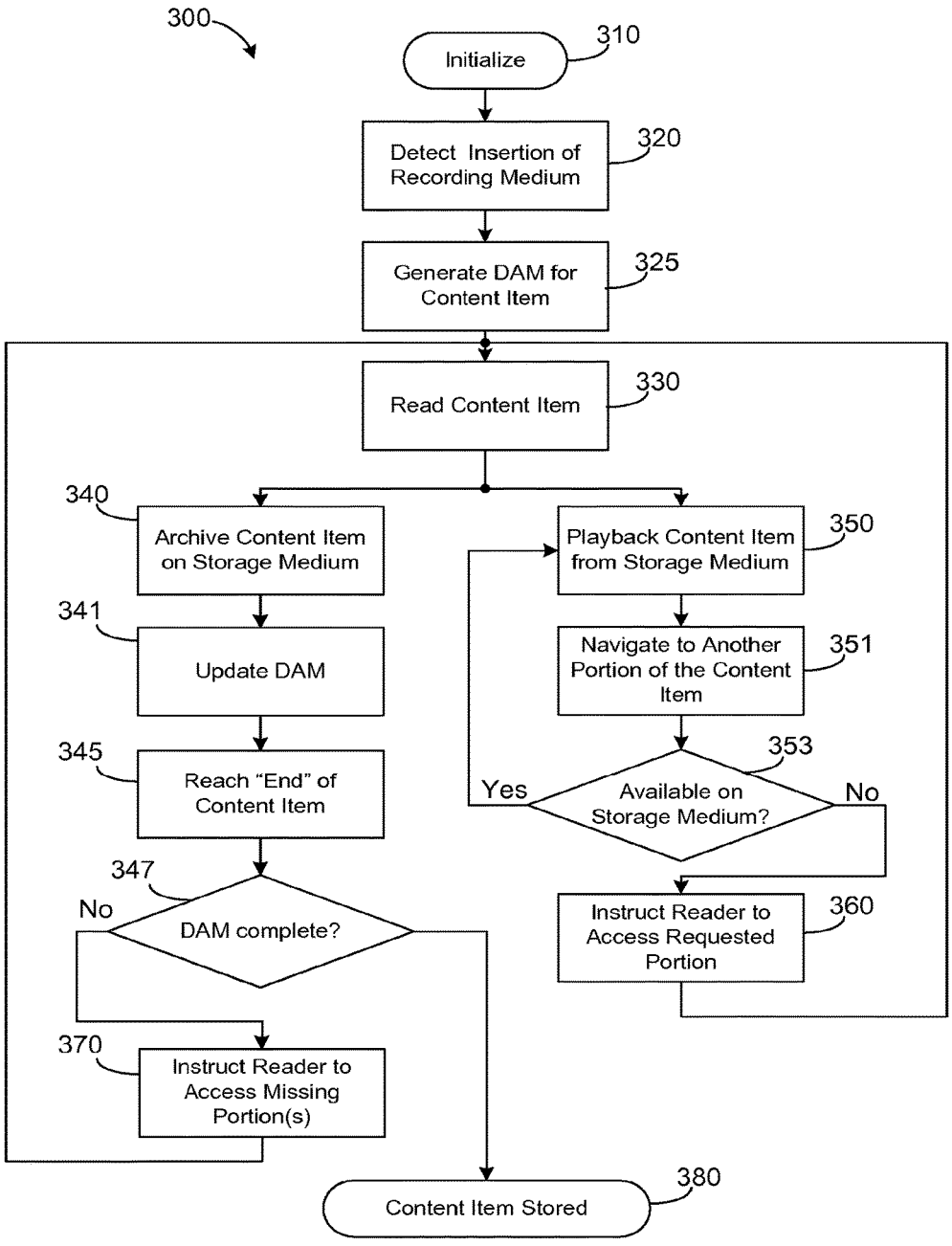
300
Initialize
310
Detect Insertion of Recording Medium
320
Generate DAM for Content Item
325
Read Content Item
330
340
Archive Content Item on Storage Medium
341
Update DAM
345
Reach "End" of Content Item
347
No
DAM complete?
370
Instruct Reader to Access Missing Portion(s)
Playback Content Item from Storage Medium
350
Navigate to Another Portion of the Content Item
351
353
Yes
Available on Storage Medium?
No
Instruct Reader to Access Requested Portion
360
Content Item Stored
380

FIG. 3A

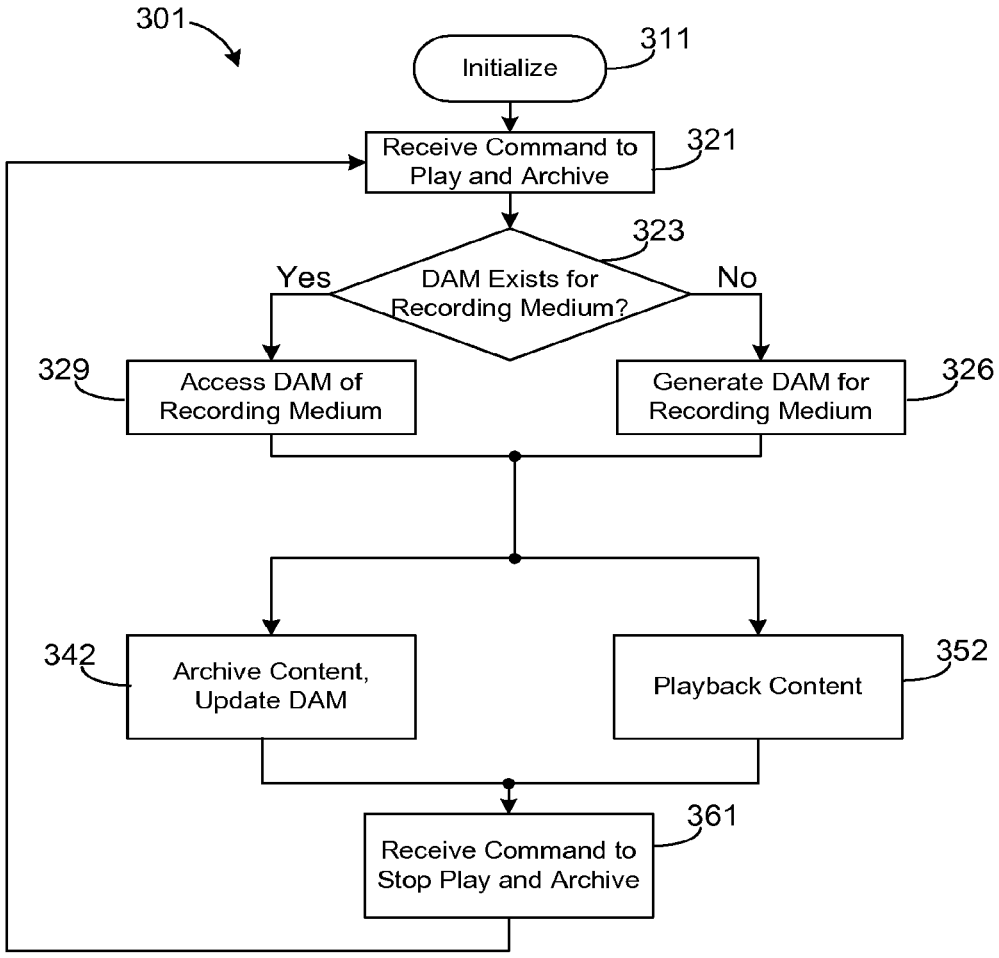
301
Initialize
311
Receive Command to Play and Archive
321
323
Yes
DAM Exists for Recording Medium?
No
329
Access DAM of Recording Medium
Generate DAM for Recording Medium
326
342
Archive Content, Update DAM
Playback Content
352
Receive Command to Stop Play and Archive
361

FIG. 3B

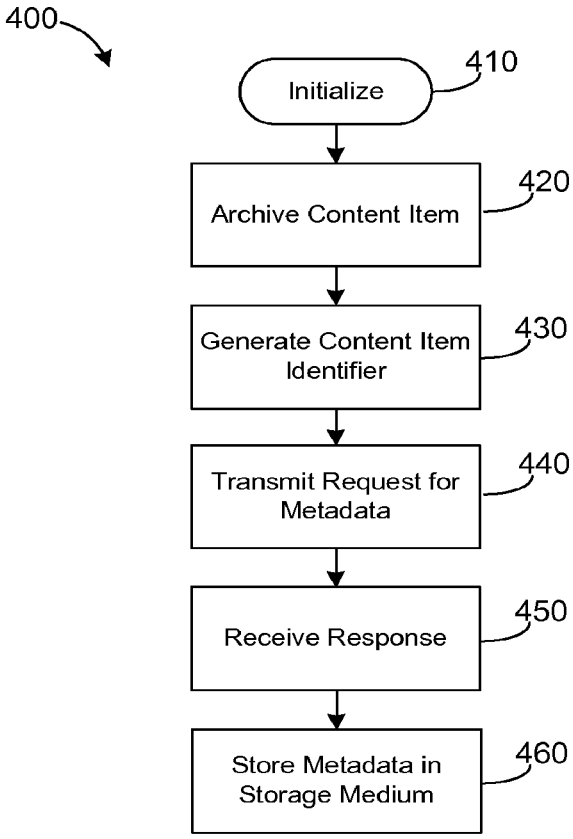
400
Initialize
410
Archive Content Item
420
Generate Content Item Identifier
430
Transmit Request for Metadata
440
Receive Response
450
Store Metadata in Storage Medium
460

FIG. 4

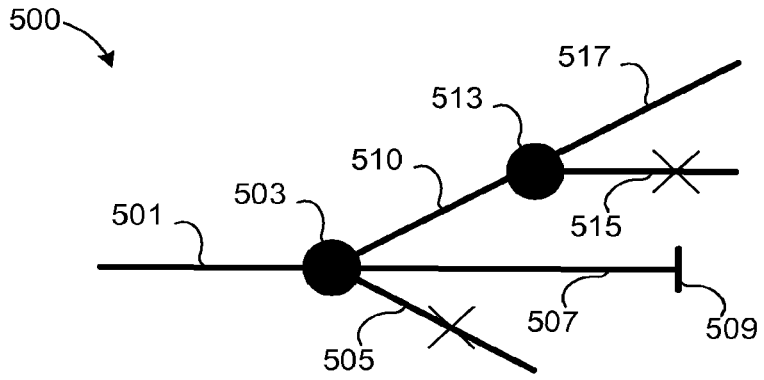

FIG. 5

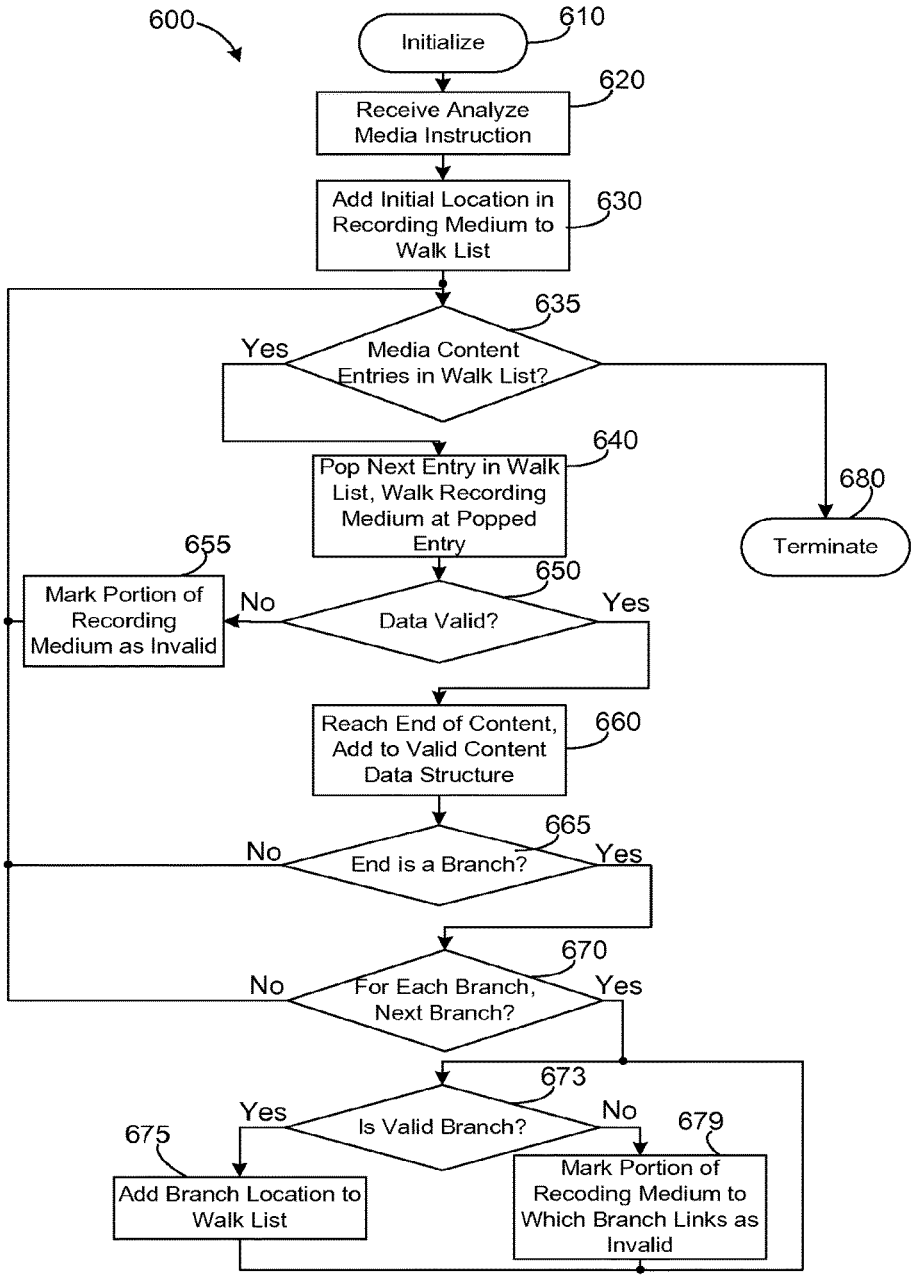
600
Initialize
610
Receive Analyze Media Instruction
620
Add Initial Location in Recording Medium to Walk List
630
635
Yes
Media Content Entries in Walk List?
640
Pop Next Entry in Walk List, Walk Recording Medium at Popped Entry
680
Terminate
655
Mark Portion of Recording Medium as Invalid
No
650
Data Valid?
Yes
Reach End of Content, Add to Valid Content Data Structure
660
665
No
End is a Branch?
Yes
670
No
For Each Branch, Next Branch?
Yes
673
Yes
Is Valid Branch?
No
679
675
Add Branch Location to Walk List
Mark Portion of Recoding Medium to Which Branch Links as Invalid

FIG. 6

SYSTEM AND METHOD FOR AUTOMATICALLY CREATING A MEDIA ARCHIVE FROM CONTENT ON A RECORDING MEDIUM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 14/073,447, filed Nov. 6, 2013, for "System and Method for Automatically Creating a Media Archive from Content on a Recording Medium," which is a continuation of U.S. patent application Ser. No. 12/332,121, filed Dec. 10, 2008, for "System and Method for Automatically Creating a Media Archive from Content on a Recording Medium," which claims the benefit of U.S. Provisional Application No. 61/012,500, filed Dec. 10, 2007, for "Video Player," and of U.S. Provisional Application No. 61/073,794, filed Jun. 19, 2008, for "Video Player," each of the foregoing applications of which is hereby incorporated herein by reference in its entirety.

TECHNICAL FIELD

The present disclosure relates to media playback and recording.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a system for automatically creating a media archive from content on recording medium.

FIG. **2**A is a flow chart of a process for archiving and playing media content from a recording medium.

FIG. **2**B is a flow chart of another process for archiving and playing media content from a recording medium.

FIG. **3**A is a flow chart of a process for tracking the archiving and playback of media content from a recording medium using a data allocation map.

FIG. **3**B is a flow chart of a process for tracking the archiving and playback of media content from a recording medium using an allocation map.

FIG. **4** is a flow chart of a process for acquiring metadata related to media content.

FIG. **5** depicts a media content graph comprising a plurality of media content segments interconnected by a plurality of branches.

FIG. **6** is a flow chart of a process for determining the structure of media content on a recording medium.

DETAILED DESCRIPTION

FIG. **1** is a block diagram of a system **100** for automatically creating a media archive from content stored on a recording medium **103**. In one embodiment, a user is not required to explicitly instruct the system **100** to create the media archive other than to initiate playback of the content (or to simply insert the recording medium). Subsequently, the user may view the media content directly from a media archive without having to use the recording medium.

In one embodiment, the system **100** includes a media player **101**. The media player **101** may include a media reader **102** capable of reading media content (e.g., movies, television shows, audio recordings, games, etc.) from a recording medium **103**, examples of which may include digital versatile discs (DVDs), Blu-Ray® discs, compact discs (CDs), solid-state memory devices, Flash memory devices, or the like. The media player **101** may also include

a user interface component **104**, an archival component **105**, a media playback component **106**, a media analysis component **107**, a transcoder **108**, a decoder **109**, a metadata component **110**, and a communication module **111**. The media player **101** may further include a computer-readable storage medium **112**, which may include one or more archived media content items (e.g., content items **113**A and **113**B). Each of the components **104-112** is described in greater detail below.

The components **104**, **105**, **106**, **107**, **108**, **109**, and/or **110** may be implemented as computer-readable instructions executable by a general purpose processor, such as a Core™ 2 Duo processor from Intel®, an Athlon™ processor from Advanced Micro Devices (AMD), or the like, and/or a special purpose processor, such as an Application Specific Integrated Circuit (ASIC), a Field Programmable Gate Array (FPGA), or the like. In some embodiments, the components **104**, **105**, **106**, **107**, **108**, **109**, and/or **110** may be implemented using a combination of processors, such as a general purpose and a special purpose processor. Similarly, one or more of the components **104**, **105**, **106**, **107**, **108**, **109**, and/or **110** may include dedicated hardware components. For example, the decoder **109** may include decoder hardware controlled by instructions executing on a general purpose processor.

The media player **101** may be coupled to a display **120**, such as a television, computer monitor, a PDA/smart phone display, etc., using one or more standard video connections, e.g., High-Definition Media Interface (HDMI), Radio Frequency (RF) coaxial, composite video, S-video, Digital Visual Interface (DVI), Video Graphics Array (VGA), or the like. The display **120** may present media content to a user **122**, who may control the operation of the display **120** and/or media player **101** using a remote control **124**. Alternatively, or in addition, the media player **101** may be communicatively coupled to a remote display **124** via a network **130**. In such an embodiment, the media player **101** may be configured to stream media content to the remote display **124** over the network **130**.

The media player **101** may include one or more inputs (not shown) to allow the user **122** to control the operation of the media player **101**. Alternatively, or in addition, the user **122** may control the operation of the media player **101** using a remote control device **123**. The user interface component **104** of the media player **101** may present controls, status information, and other interface components on the display **120** and/or the remote display **124**. The user **122** may interact with the user interface presented by the user interface component **104** to view the status of the media player **101** and/or control its operation.

As will be described in additional detail below, an archival component **105** of the media player **101** may be configured to archive at least a portion of the media content on the recording medium **130** on the computer-readable storage medium **112**. FIG. **1** shows examples of archived content items **113**A and **1136**.

In one embodiment, the media content on the recording medium **103** may be concurrently archived by the archival component **105** and played back by the playback component **106** e.g., in a single "play and save" operation. As such, the user interface component **104** may provide a "play and save" user interface input element. Selection of the play and save input by a user **122** may cause the archival component **105** to begin archiving and playing the media content on the recording medium **103**.

Alternatively, or in addition, the archival may commence as soon as the recording medium **103** is made available to

the media player **101**. For example, the archival component **105** may begin archiving a recording medium **103** as soon as the medium **103**, such as a DVD disc, is inserted into the media reader **102**.

As shown in FIG. **1**, the storage medium **112** may store one or more archived media content items (e.g., content items **113**A-**113**B). The storage medium **112** may include, but is not limited to one or more hard discs (e.g., discs comprising magnetic storage medium), optical media, volatile memory, non-volatile memory, Flash memory, or the like. In some embodiments, portions of the storage medium **112** may be disposed within the media player **101** and other portions of the storage medium **112** may be disposed externally of the media player **101**. The portions of the storage medium **112** disposed outside of the media player **101** may be communicatively coupled to the media player **101** via a Universal Serial Bus (USB) connection, an IEEE 1394 (Firewire®) connection, a network connection, or the like. In some embodiments, the storage medium **112** may include a plurality of storage devices, such as a Redundant Array of Inexpensive Discs (RAID), a storage area network (SAN), a network-attached storage (NAS), a cluster, or other data storage configuration. Similarly, portions of the storage medium **112** may be removable from the media player **101**. For example, discs may be swapped into and out of the media player **101**, flash or other memory types may be inserted and/or removed from the media player **101**, and so on.

After the multimedia content on the recording medium **103** is archived in the storage medium **112** (e.g., content items **113**A and **113**B), the content may be played by the playback component **106** of the media player **101** without requiring the recording medium **103** to be inserted into the player **101**. Similarly, the playback component **106** may play media content from the storage medium **112** as it is archived by the archival component **105** (e.g., concurrently with archiving the media content **103**). Collectively, the stored content items **113**A and **1136** are referred to herein as a content "archive" or "library."

As an example, a user may have a DVD movie collection including dozens or even hundreds of DVDs. As each DVD movie is played in the media player **101**, a backup or archive of the movie may be stored on the storage medium **112**. Archival may take place upon insertion of the recording medium **103** into the media reader **102** or in response to a single command to play and save the recording medium **103** received via the user interface component **104** (e.g., via a "play and save" user interface element). Once the contents of the DVDs have been added to the media archive, subsequent playback using the playback component **106** may occur without having to handle the recording medium **103**. In this way, a media archive may be automatically created as one or more users of the media player **101** play various recording media (e.g., such as the recording medium **103**), without requiring the one or more users to perform a dedicated archiving step.

In some embodiments, the media analysis component **107** of the media player **101** may be configured to analyze the recording medium **103** as the recording medium **103** is archived in the storage medium **112**. The media analysis component **107** may allow the media player **101** to determine the structure of the media on the recording medium **103**. For example, a DVD movie stored on the recording medium **103** (e.g., a DVD movie disc) may include various segments, such as one or more previews, one or more special features, one or more menus, the movie itself (e.g., comprising one or more "chapters"), and so on. The media analysis component **107** may identify each segment on the recording medium **103**. The data describing the structure of the recording medium **103** may be stored in the storage medium **113** in association with its respective content item (e.g., content item **113**A-**113**B). The data describing the structure of the content item ("content item structure data") may include a map relating content item features (e.g., preview, menu, and so on) to locations within the archived content item.

Using the content item structure information, the media player **101** may allow the user **122** to skip to any portion or segment of a content item. For example, the user **122** may direct the media player **101** (e.g., via a user interface presented by the user interface component **104**) to immediately begin playing a particular chapter of an archived DVD movie, skipping the previews, menu, and the like.

The content item structure data may further include one or more user-defined bookmarks. The user-defined bookmarks may point to arbitrary positions within a content item. For example, the user **122** (through the user interface component **104**) may cause the media player **101** to create a bookmark to a particular portion of an archived DVD movie. This may allow the user to return to the bookmark without navigating through the DVD chapter menu or the like. The content item structure information, including any user-defined bookmarks, may be stored as content item metadata (e.g., metadata **114**A and **114**B) within the storage medium **112**.

The media analysis component **107** may also be used to detect and/or avoid media obfuscation schemes. The recording medium **103** may include obfuscated data. Such obfuscation data may include one or more "bad sectors" on the recording medium **103**, which may cause a sequential archival of the recording medium **103** to fail. For instance, the obfuscation sectors may be linked together in an infinite loop and/or the sectors may be configured to intentionally cause read failures and/or timeouts. Successive timeouts and/or read failures due to the bad sectors may cause an archiving process to fail and/or take an inordinate amount of time (in the case of an infinite loop, the archival may never complete).

The media analysis component **107** may be used to analyze the recording medium **103** (e.g., "walk" the recording medium **103**) to determine the valid portions thereof. The media analysis component **107** may execute virtual machine instructions to allow the media analysis component **107** to emulate the operation of a standard media player (e.g., a normal DVD player). During a walk operation, the media analysis component **107** may access the recording medium **103** from its beginning (e.g., at the "first-play" program chain). The walk may follow the program chain as a standard media player would until a branch or other terminator is reached. In some cases, the media data read from the recording medium during the walk process may be discarded as quickly as possible. This may allow the media analysis component **107** to quickly walk the recording medium **103**. Alternatively, the media analysis component **107** may read the media data from the recording medium **103** for archival by the archival component **105**.

When the walk process reaches a branching point (e.g., menu), the media analysis component **107** may store a record of both its current state and the state after following each branch (e.g., each menu option). The current state and branch state may be stored in a media walk data structure (e.g., a stack), which may be used to determine which portions of the recording medium **103** have been visited by the walk process. A branch may be implemented as DVD instructions interpretable by the virtual machine emulator of

the media analysis component **107**. The media analysis component **107** may follow each branch to thereby determine whether the branch represents valid data.

Alternatively, or in addition, before following a branch and/or adding the branch state to a media walk data structure, the media analysis component **107** may determine whether the branch is likely to lead to valid data. For example, if a branch is reachable by an "invalid" menu option, the portion of the recording medium **103** corresponding to the branch (and data on the recording medium **103** associated therewith) may be marked as "bad" and ignored. The media analysis component **107** may detect invalid menu options in a number of different ways. For example, a menu option that falls outside of the viewable area of a display, is "invisible," is very small, is displayed for only a few frames, or the like, the media analysis component **107** may be considered an invalid menu option. However, other invalid menu item detection techniques could be used according to the nature of the obfuscation scheme in use on the recording medium **103**.

The current state of the media walker and the state of the walker after following any of the links may be stored in a media walker data structure (e.g., on a stack-type data structure). The media analysis component **107** may walk each branch of the recording medium **103** in the data structure as described above. Subsequent branches may be similarly evaluated and/or followed as described above. Upon reaching the end of a branch segment, the media analysis component may recursively traverse any remaining branches in the media walker data structure. If a branch leads to bad sectors, is circular (links back to an area of the disc already visited by the walk process), is an infinite still frame, is unreachable by other portions of the DVD, or the like, the branch (and portions on the recording medium **103** associated therewith) may be marked as "bad." The branch evaluation and walking process may continue until all valid sectors on the recording medium **103** have been identified (e.g., until all branches on the recording medium **103** have been evaluated and/or walked). The result of the walk operation may be a graph data structure of the recording medium **103** comprising the valid branches and/or sectors thereon.

The walk process of the media analysis component **107** may be performed concurrently with archival and/or playback of the recording medium **103**. As such, the media analysis component **107** may communicate with the archival component **105** and/or playback component **106** to synchronize the walk operation such that the portions of the recording medium **103** read by the media analysis component **107** correspond to the portions requested by the archival and/or playback components **107** and **108**. Similarly, the operation of the components **104**, **107**, and **108** may be synchronized to minimize disc seeking. In this way, the media analysis component **107** may analyze the structure of the recording medium **103** without disrupting archival and/or playback of the recording medium **103**.

The storage medium **112** may have sufficient storage space to hold a particular amount of media content (e.g., a particular number of DVD movies or the like). For example, the storage medium **112** may have sufficient storage capacity to allow for the storage of twenty (20) to one hundred (100) movies. In some embodiments, however, the storage medium **112** may be expandable with additional internal and/or external storage to allow the media player **101** to hold an arbitrary amount of media content.

In some embodiments, the media storage capacity of the storage medium **112** may be increased by compressing the media content stored thereon. Video and/or audio content items on the recording medium **103** may be encoded in a first encoding format. For example, DVD movies on a DVD disc recording medium **103** may be encoded in the Motion Picture Experts Group 2 (MPEG-2) format. In addition, the DVD movie content may be encrypted (e.g., scrambled) using an encryption scheme, such as Content Scramble System (CSS), Data Encryption Standard (DES), Blowfish, or the like. The encryption may serve a digital rights management (DRM) function to prevent unauthorized replication and/or playback of the content on the recording medium **103**.

In one embodiment, the media player **101** is configured to re-encode content read from the recording medium **103** as it is archived on the storage medium **112**. For example, content originally encoded in the MPEG-2 format may be transcoded into a second (different) format, such as H.264, VC-1, RealVideo®, or the like. The transcoding may be performed in real-time or at such times as the media player **101** is not performing other tasks. Similarly, the media player **101** may be configured to decrypt (e.g., unscramble) content on the recording medium **103**. The decrypted and/or transcoded content may be stored on the storage medium **112** and/or made available for display (e.g., on the display **120** and/or the remote display **124**).

As described above, the decryption and/or transcoding operations of the transcoder may be implemented using a general purpose processor, special purpose processor, and/or one or more special purpose hardware components.

The transcoder **108** may be configured to re-encode content items (e.g., content items **112**A and/or **112**B) according to various different encoding formats. Alternatively, or in addition, the transcoder **108** may be configured to automatically transcode content read from the recording medium **103** as it is read by the media reader **102**.

As an example, the storage medium **112** of FIG. **1** includes content items **113**A and **113**B, each of which may have been encoded using MPEG-2, a relatively inefficient encoding format. In one embodiment, the content items **113**A and **113**B may be re-encoded using H.264, which produces substantially smaller files while preserving the same quality. As a result, the storage medium **112** may hold additional content items. Similarly, the recording medium **103** may include content encoded in the MPEG-2 format. As the archival component **105** stores the media content in the storage medium **112**, the transcoder **108** may automatically transcode the media (e.g., into H.264, or another encoding format).

In addition to improving storage utilization, content may be transcoded from formats for which direct hardware decoding is not readily available. For instance, the decoder **109** of the media player **101** may be configured to decode one or more media encoding formats. As discussed above, the decoder **109** may include computer-readable instructions executable by a general or special purpose processor and/or may comprise one or more hardware components.

However, the recording medium **103** and/or content items stored on the storage medium **112** may be encoded in a format that is not supported by the decoder **109**, such as content encoded using Microsoft's Windows Media Video (WMV) encoding format. As such, in order to play back the content, the media player **101** may have to decode the WMV content using a software decoding process (e.g., on a general purpose processor (not shown)), which may be computationally expensive and, in some cases, may produce sub-par results. Accordingly, the transcoder **108** may be configured to transcode the content into a format that is decodable by

the decoder **109**. This may allow the media player **101** to leverage the software and/or hardware decoding resources available on the media player **101** to provide for efficient, high-performance content playback.

Similarly, in some embodiments, the media player **101** may be configured to transmit media content to a remote display, such as the remote display **124**. The remote display **124** may be communicatively coupled to the media player **101** via a network **130**. The network **130** may include any communications network known in the art including, but not limited to a Transmission Control/Internet Protocol (TC/IP) network, a wireless network (e.g., IEEE 802.1a-n network, Bluetooth®, or the like), a cellular network (e.g., a 3G network or the like), a Local Area Network (LAN), a Wide Area Network (WAN), the Internet, or the like. The media player **101** may include a communications module **111** which may be configured to communicatively couple the media player **101** to the network **130**. Accordingly, the communications module **111** may include one or more communications interfaces, such as an Ethernet® communications interface, a wireless network interface, a Bluetooth® interface, a cellular telephone interface, a Public Switched Telephone Network (PSTN) interface, or the like.

The transmission of content from the media player **101** to the remote display **124** may include streaming the content to the remote display **124** over the network **130**. The transcoder **108** may be configured to transcode media content read from the recording medium **103** and/or stored in the storage medium **112** into a format suitable for transmission to and/or display on the remote display **124**. For example, video content encoded using MPEG-2 may be transcoded into a RealVideo® stream, which may be efficiently transmitted to the remote display **124** via the network **130**. The nature of the transcoding may depend upon the bandwidth available to the media player **101** and the remote display **124** and/or the capabilities of the remote display **124**. For instance, the remote display may include one or more decoders capable of decoding media content in a particular encoding format. The media player **101** may be configured to determine which formats are supported and/or preferred by the remote display **124** and to transcode the media content transmitted to the remote display **124** accordingly.

As discussed above, the transcoder **108** may transcode media content as it is read from the recording medium **103** and/or after archiving the media content on the storage medium **112**. The transcoder **108** may transcode code media content for various purposes including, but not limited to decrypting (e.g., unscrambling) the media content, compressing the media content (e.g., to increase the virtual storage capacity of the storage medium **112**), transcoding the content into a format for which hardware decoding is available (e.g., into a format adapted for the decoder **109**), transcoding the media content into a streamable format, transcoding the media content into a format suitable for display on a remote display device, such as the remote display **124**, or the like.

As discussed above, the user interface component **104** of the media player **101** may allow the user **122** to control the operation of the media player **101**. Control instructions may be received via a remote control device **104** and/or via one or more interfaces on the media player **101** (e.g., controls disposed on the player **101**, such as buttons, toggles, and the like) and/or controls presented on the display **120**. For instance, the display **120** may be a touch screen display. The media player **101** may cause one or more control interfaces to be presented on the display **120** to allow the user **122** to control the operation of the media player **101**.

The user interface component **104** may provide a "play and save" input. Selection of the "play and save" input may cause the media player **101** to archive the media content on the recording medium **103** while playing back the media content on the display **120** and/or remote display **124**. As such, the recording medium **103** may be concurrently archived and played by invoking a single command. Alternatively, or in addition, the media player **101** may be configured to begin archiving the recording medium **103** upon detecting insertion of the recording medium **103** into the media reader **102**.

As discussed above, the media player **101** may be configured to display media content stored on the recording medium **103** while concurrently storing the media content in the storage medium **112**. In this way, an archive or library of stored content items (e.g., content items **113**A-**113**B) may be created while the user **122** views the content. Accordingly, the user **122** need not archive the media content in a separate step (e.g., the user **122** need not separately archive and view the content items **113**A-**113**B since the content items **113**A-**113**B are stored as the user views the respective content items). Similarly, a user **122** may archive the media content on a recording medium **103**, while playing back archived media content (e.g., content items **113**A or **113**B). The media reader **102** may be capable of reading the recording medium **103** faster than the normal playback speed. For instance, the recording medium reader **102** may be capable of reading data from the recording medium **103** at 4X to 16X, i.e., four (4) or sixteen (16) times playback speed. Accordingly, the media player **101** may be capable of archiving the media content on the recording medium **103** before the user **122** is finished viewing the content item. In such an embodiment, the playback component **107** may be configured to play media content read from the storage medium **112** rather than from the recording medium **103** directly.

The user interface component **104** of the media player **101** may include controls to allow the user **122** to control the playback of the media content. For example, as the media player **101** concurrently plays back and archives media content on a recording medium **103**, the user **122** may instruct the player **101** to navigate to a different location within the content (e.g., fast forward within the content, jump a particular chapter or section, or the like).

These instructions may be received before all of the media content has been archived on the storage medium **122**. When the media player **101** receives such a navigation instruction, the player **101** may determine whether the requested content has been stored on the storage medium **122**. If the media content is not yet available on the storage medium **122**, the archival component **105** may "skip" to the requested location and to continue archiving the media. This may allow the playback component **106** to play the media at the requested location (e.g., by reading the requested location within the media content from the storage medium **112**). If the requested media content has already been archived, the playback component **106** may obtain the requested content from the storage medium **112** and display the content for the user **122**.

To track which portions of the media content on the recording medium **103** have been archived (e.g., stored on the storage medium **112**), the archival component **105** may maintain a data allocation map (DAM) associated with the media content on the recording medium **103**. In some embodiments, the DAM may include a table-like data structure comprising a list of sectors on the recording medium (or other delimiters, such as cells, nodes, or the like) with respective, corresponding indications a status of the portion

of the recording medium. The status may indicate whether the portion of the recording medium **103** has not yet been accessed; whether the portion of the recording medium **103** has been archived (e.g., stored in the storage medium **112**); whether a read error and/or timeout was encountered when the portion of the recording medium **103** was accessed (e.g., the portion of the recording medium **103** may be damaged); whether the portion of the recording medium **103** contains invalid data; and the like. As various sectors of the media content are accessed and stored in the storage medium **112**, the archival component **105** may update the DAM to indicate that the sectors have been archived and are available for playback from storage medium **112**.

Using the DAM, the playback component **106** may determine whether a particular portion (e.g., sector) of the media content of the recording medium **103** is available on the storage medium **112**. Similarly, the DAM may be used by the archival component **105** to "fill in" any missing (e.g., un-archived) sectors of the media content item on the storage medium **112**. For example, a user may insert a DVD recording medium **103** into the media player **101** and immediately navigate to an ending portion of the media content (e.g., a last chapter of the DVD movie). Similarly, a user may insert a DVD, play a portion of the DVD, and then eject it before the archival component **105** finishes archiving the media content thereon. As described above, during navigation and/or reinsertion of the recording medium **103**, the media player **101** may access the DAM associated with the recording medium **103** to determine whether the requested portion has been archived. If not, the media player **101** may direct the archival component **105** to navigate to the requested portion of the recording medium **103**, and the content may be archived and made available for playback as described above. The archival of the requested portion of the content may allow the playback component **106** to play the media content from the storage medium **112**. After the media player **101** has archived the requested portion of the recording medium (e.g., the "end" of the media content), the archival component **105** may be configured to go back and archive any skipped portions of the content. The skipped (un-archived) portions of the content item may be identified using the DAM. Similarly, if the DAM indicates that read errors were encountered during archival, the archival component **105** may attempt to re-archive those portions of the recording medium **103**.

The metadata component **110** of the media player **101** may be configured to receive and associate one or more pieces of data (e.g., metadata) with content items stored in the storage medium **112**. The metadata may include descriptive information associated with a respective content item (e.g., metadata **114**A may describe the content item **113**A, and the metadata **1146** may describe the content item **113**B). The metadata may include one or more metadata items relating to a content item (e.g., DVD movie, audio track, or the like) and may include, but are not limited to, a title of a content item, a table of contents, a rating, a credits listing, a plot synopsis, one or more graphical assets (e.g., an image of a DVD movie cover, image(s) associated with a scene (which may comprise a reference to such image(s) within the content item), or similar), one or more tags, one or more content item categories, a content item genre, and so on.

The metadata component **110** may receive metadata associated with a content item (e.g., metadata **113**A an **1136**) from the user **122** via the user interface component **104** (e.g., the user **122** may manually input metadata describing the content). Alternatively, or in addition, the media player **101** may be configured to obtain metadata relating to a content item from a metadata provider **132** accessible via the network **130**. The metadata component **110** may be communicatively coupled to the metadata provider **132** via the network **130**. In some embodiments, the metadata provider **132** may include and/or be communicatively coupled to a metadata data store **133**. The metadata data store **133** may include metadata relating to a plurality of different content items (e.g., DVD movies or the like). Alternatively, or in addition, the media player **101** may include a local metadata data store (not shown) similar to the data store **133**, which may include metadata relating to various content item (e.g., DVD movies, music albums, or the like). The local metadata store may be pre-loaded with metadata relating to various content items (e.g., metadata of hundreds or thousands of DVDs, CD, and so on). The local metadata data store may be periodically updated via the network **130**, updated via the media reader **122** (e.g., a recording medium **103** may include additional metadata), updated by a removable storage medium, or the like.

To receive metadata information relating to a content item from the metadata provider, the metadata component **101** may generate and transmit metadata query to the metadata provider **132**. The query may identify the content item for which metadata is requested. The content item identifier may include, but is not limited to a title of the content, a table of contents, a DVD media identifier, a value derived from one or more identifiers (e.g., a hash value or the like), a combination of identifiers, or other identifying information. The content item identifier may be transmitted to the metadata provider **132** (e.g., in a query for metadata), and may be used by the metadata provider **132** to look up metadata related to the content item in the metadata data store **133**. Upon accessing the metadata information, the metadata provider **132** may transmit the information to the metadata component **110** via the network **130**.

The metadata component **110** may be configured to store the metadata received from the metadata provider **132** in the storage medium **112**. The metadata may be associated with (e.g., linked to) a respective content item in the storage medium **112** (e.g., the metadata **114**A may be associated with content item **113**A, and metadata **114**B may be associated with content item **113**B). The association may be made by a database association (e.g., as a table within a database, as a key value, or the like), a data structure association (e.g., within an XML or other structured data format), or the like.

The user interface component **104** may display metadata associated with one or more a content items. For example, the user interface component **104** may display content items **113**A-**113**B stored on the storage medium **112** in a list or other selection interface. Each content item in the list may be displayed in conjunction with one or more pieces of metadata. For example, a DVD movie content item **113**A may be displayed using metadata content, such as a graphic of the DVD movie cover, the DVD movie title, a scene from the DVD movie, a DVD movie rating, a plot synopsis, a genre, one or more tags, or the like.

The user interface component **104** may include various different content item display interfaces. For example, the user interface component **104** may include display interfaces that include only content items of a particular genre (e.g., action), a particular rating, or the like. The metadata of the content items **112**A-**112**B stored may be used to determine whether a particular content item should be included in the list.

The metadata **114**A and **1146** associated with the content items **113**A and **1136** may allow for sorting and/or searching

thereof. For example, a user may search the content items **113**A-**113**B for a particular actor name (e.g., "De Niro"). Responsive to the search, the user interface component **104** may cause a listing of content items having the term "De Niro" in the list of actors to be presented on the display **120**. Any search term pertaining to any metadata category and/or type could be used under the teachings of this disclosure.

FIG. **2**A is a flow chart of one embodiment of a process **200** for concurrently archiving and playing a content item. At step **210**, the process **200** may be initialized by allocating and/or initializing required resources, such as memory, storage locations, network connections, device (e.g., a media reader device), and the like.

At step **220**, a recording medium may be inserted in a media reader. For instance, the recording medium may include a DVD movie, and the media reader may be a DVD media reader.

At step **230**, the process **200** may instruct the reader to begin reading the content from the DVD media at a media read rate. As discussed above, many media readers are capable of reading data at a higher rate than playback speed (e.g., 16X playback speed).

At step **240**, media content read from the media reader may be archived in a storage medium.

At step **250**, and concurrently with step **240**, the media content archived in the storage medium may be accessed and presented on a display. Since, as discussed above, the media reader may be capable of reading data from the media at or above playback speed, the playback of step **250** may occur concurrently with the archiving of step **240**.

At step **245**, the storage of the content item in a storage medium may complete, and, at step **255**, the playback of the content item may complete. As discussed above, since the media reader may be capable of reading media at or above playback speed, the storage of the content item at step **245** may complete before the playback of the content item at step **255**.

As discussed above, after archiving the content item on the storage medium, the content item may be made available for subsequent playback. The content item may be played back directly from the archived content in the storage medium and, as such, may not require the recording medium (e.g., DVD disc) to be present in the media reader for playback.

FIG. **2**B is a flow chart of another embodiment of a process **201** for concurrently archiving and playing a content item. At step **211**, the process **200** may be initialized as described above in conjunction with step **210** of FIG. **2**A. At step **221**, an instruction to "play and save" a content item stored on a recording medium may be received. The instruction may be received by means of a remote control device, one or more inputs disposed on a surface of a media player, or the like. The play and save instruction may, in a single step, cause the process **201** to concurrently archive and playback a content item stored on a recording medium. The concurrent archival and playback of steps **231**-**256** may be performed as described above in conjunction with steps **230**-**255** of FIG. **2**A.

FIG. **3**A is a flow chart of one embodiment of a process **300** for concurrently storing and playing back a content item. At steps **310** and **320**, the process **300** may be initialized, and a recording medium may be inserted into a media reader as described above.

At step **325**, a data allocation map (DAM) may be generated for the content on the recording medium. As described above, the DAM may include a map of the portions of data available on the media (e.g., arranged into sectors, chapters, nodes, or the delimiter types). Each of the portions on the media may be associated with an indicator showing the status of the respective portion. The DAM may support various different indicators including, but not limited an indicator that the portion has been archived (e.g., is stored on a storage medium); an indicator that the portion has been accessed for archiving (e.g., no attempt has yet been made to archive the portion of the recording medium); an indicator the last attempt to access the portion resulted in a read error or timeout; an indicator that the portion of the recording medium comprises invalid data (e.g., as indicated by a media analysis component, such as the component **107** of FIG. **1**); and so on. For example, the indicator of a particular portion may be a Boolean and/or bitwise indicator (e.g., bitmask) to reflect one or more of the states discussed above (e.g., a bitwise one (1) may indicate that the portion has been archived, a bitwise zero (0) may indicate that the portion has not been accessed, a two (2) may indicate an error was encountered, and so on).

At steps **330**, **340**, and **350**, the process **300** may direct the media reader to begin reading media content from the media, to archive the media content in a storage medium, and to playback the stored media content as described above.

The archiving of step **340** may take place over time. For example, the media reader may sequentially read portions of the content item from the recording medium. As each portion (e.g., sector, segment, or other delimiter) of the content item on the recording medium is read, it is archived at step **340**. If a portion of the recording medium is successfully archived, the DAM may be updated accordingly. If a reading error and/or timeout is encountered, the process **300** may re-try reading the portion a threshold number of times. The read attempt threshold may be adaptable according to the progress of the playback portion of the process **300** (e.g., at steps **350**-**353** below). For example, if the playback process is occurring in the logical vicinity of the portion, the number of read attempts may be reduced to prevent the attempts from interfering with the playback. Alternatively, if the playback process is not playing back media content in the logical vicinity of the portion, the number of read attempts may be increased since the read attempts are unlikely to interfere with playback.

The archiving of step **340** may be performed in conjunction with a media analysis component, such as the media analysis component **107** of FIG. **1**. As discussed above, the media analysis component may walk the recording medium to determine which portions of the recording medium contain valid media data, and which do not. This information may be stored in a graph, a list, or other data structure describing the structure of the recording medium. As such, at step **340**, the process **300** may use the information gathered by the media analysis component to avoid portions of the recording medium that have been marked as containing "invalid data" (e.g., may consult the graph, list, or other data structure before identifying the valid and invalid portions of the recording medium before attempting to archive a portion of the recording medium). Similarly, in other embodiments, at **340** the process **300** may restrict the archiving to only the portions of the recording medium identified by the media analysis component as containing valid media content.

At step **341**, the DAM may be updated to reflect the status of the portion of the recording medium. For example, if the portion of the recording medium was successfully archived, the corresponding entry in the DAM may be updated to indicate that the portion is available on the storage medium. If a read error and/or time out was encountered, the DAM

may be updated to indicate the error. In some embodiments, the error indicator may indicate the number of attempts made to read the content. Similarly, the DAM may be updated to indicate that a media analysis component determined that the portion contains invalid data.

At step **351**, the process **300** may receive an instruction to navigate to another portion of the content item on the recording medium. For example, the process **300** may receive an instruction to navigate to a particular chapter within a DVD movie. The navigation instruction of step **351** may be received from a user of the process **300** via a user interface (e.g., user interface **112** of FIG. **1**).

At step **353**, the process **300** may determine whether the portion of the media content item requested at step **351** has been archived and is available for playback from the storage medium. The determining of step **353** may include accessing the DAM associated with the content item. If the DAM indicates that the portion could not be archived due to a read error and/or timeout, the portion may be skipped by the playback, and a "next" navigation may be directed to the next "good" portion of the recording medium. The "next" portion may be the following segment of the recording medium and/or a portion linked to the segment in the recording medium. This skipping may cause the playback to jump around the damaged portion of the recording medium. If the requested portion (or next good portion) of the recording medium is available, the flow may continue at step **350** where the process **300** may play the requested portion of the content item from the storage medium. If the requested portion is not available, the flow may continue at step **360**.

At step **360**, the process **300** may instruct the media reader to access the requested portion of the content item. This may cause the media reader to "skip" to another portion of the recording medium. After navigating to the requested portion of the recording medium, the process **300** may read the content item from the requested position at step **330**. The requested portion will be archived at step **340**, and the DAM will be updated at step **341**. As such, the requested portion of the content item may be played back from the storage medium at step **350** as described above.

At step **345**, the media reader may reach an "end" of the content item. At step **347**, the DAM may be evaluated to determine whether all of the content item has been archived on the storage medium. As described above, the content item may not be stored sequentially due to user navigation within the content item. As such, the DAM may have one or more gaps. At step **347**, the DAM may be accessed to determine whether any portion of the content item has not been archived (e.g., whether any of the entries in the DAM are "FALSE" or zero (0)). If no such portions remain, the content item has been completely archived, and the flow may terminate at step **380**.

At step **370**, if portions remain to be archived, the process **300** may instruct the media reader to access the un-archived portions of the content item on the recording medium. The missing portions of the recording medium may then be archived in the storage medium at steps **340** and **341**, as described above. Since the process **300** plays back the content item from the storage medium, the navigation and archival of steps **370**, **340**, and **341** may be performed concurrently with playback of the content item without interfering with the playback of the content item.

FIG. **3**B is a flow chart of another embodiment of a process **310** for archiving and playing back media content from a recording medium. At step **311**, the process **301** may be initialized as described above.

At step **321**, a command to play and archive media content on a recording medium may be received. The command of step **321** may be received via a user interface component (e.g., via a user interface input produced by the user interface component **104** of FIG. **1**). Alternatively, or in addition, the command of step **321** may be produced responsive to detecting insertion of a recording medium into a media reader (e.g., detecting the insertion of a DVD disc into a DVD reader of a media player).

At step **323**, the process **301** may determine whether a DAM exists for the recording medium in the media reader. In some embodiments, this may comprise generating a recording medium identifier or media content identifier. Examples of various recording medium and/or media content identifiers are provided below in conjunction with FIG. **4**. Upon generating the identifier, the process **301** may determine whether a DAM has been associated with the identifier, by querying a storage medium for the DAM using the identifier (e.g., the storage medium **112** of FIG. **1**). For example, the storage medium may include a relational database or other data relational system (e.g., search functionality provided by the storage medium). DAM data structured stored on the storage medium may be associated with the identifier (e.g., as a "key" of a database table of the DAM or the like). If a DAM for the recording medium exists, the flow may continue at step **329**; otherwise, the flow may continue at step **326**.

At step **326**, a new DAM may be generated for the recording medium as described above. The DAM may be keyed to a recording medium identifier and stored in a storage medium for subsequent access by the process **301**.

At step **329**, the existing DAM for the recording medium may be accessed. The existing DAM may indicate that portions of the recording medium have already been archived in the storage medium. As such, the process **301** may not need to re-archive the entire recording medium, rather only those portions of the recording medium which, as indicated by the DAM, have not yet been archived. Similarly, playback of the archived portions of the recording medium may be possible without re-archiving. In addition, the existing DAM may include media analysis information (e.g., a graph or other structure generated by the media analysis component **107** of FIG. **1**). The media analysis information may indicate which portions of the recording medium are valid, which contain errors (e.g., scratches), and so on.

At step **342**, the process **301** may read content from the recording medium, archive the content in a storage medium, and update the DAM as described above. Also as described above, at step **352**, media content may be played back from the storage medium. Although not depicted in FIG. **3**B, the reading and archiving of step **342** may navigate to different portions of the recording medium responsive to the playback. For example, a user may request playback of a portion of the recording medium that has not yet been archived. Responsive to such a command, the recording medium may be read and archived at step **342** at the requested location as described above.

At step **361**, a command to stop the play and archive process may be received. The command of step **361** may be received via a user interface input. Alternatively, or in addition, the command may be produced responsive to the recording medium being ejected from the media reader.

The command of step **361** may be received before the recording medium has been fully archived (e.g., before all of the media content on the recording medium has been stored on the storage medium). However, the partial archive (and

DAM associated therewith) may be maintained on the storage medium. Upon subsequent insertion of the recording medium (or command to play and/or archive the recording medium), the process **301** may pick up where it left off. In some embodiments, the partial archive may be maintained on the storage medium indefinitely. Alternatively, the partial archive may be maintained for a threshold period of time or may be maintained as long as there is sufficient storage space within the storage medium (e.g., after a threshold period of time and/or upon detecting that the storage medium is running low on storage space, the partial archive may be removed). Similarly, a user interface option may allow a user to decide whether and/or how long the partial archive should be maintained. If sufficient media content has been stored, playback of the partially archived media content may be provided as described above.

After receiving the command of step **361**, the process **301** may return to step **321** where a command to archive the recording medium may be received. As discussed above, the command of step **321** may be received responsive to detecting insertion (or re-insertion) of the recording medium into the media reader). Similarly, the command of **321** may be received via a user interface component. As shown in FIG. **3**B, after receiving the command of step **321**, the process **301** may continue the archival of the recording medium where the process **301** left off; the DAM may be detected and accessed at steps **323** and **329**. Using the DAM, the process **301** may determine which of the recording medium remain to the archived. In this way, the process **301** may not have to re-archive portions of the recording medium that have already been stored, attempt to archive portions of the recording medium that contain invalid data (e.g., as indicated by a graph or other structured generated by a media analysis component), and so on.

As discussed above, in some embodiments, the DAM indicator of a particular portion of the recording medium may include a plurality of indictors including, but not limited to an "archived" indicator to indicate that the portion has been stored on the storage medium; an un-archived indicator to indicate that the portion has not yet been stored on the storage medium; an indicator that the portion of the storage medium contains invalid data; and/or an "error" indicator to indicate that a read error was encountered during archiving.

In some embodiments, at step **342**, the process **301** may ignore portions of the recording having an "error" indicator in the DAM. This may speed up the archiving by preventing attempts at archiving portions of the recording medium thought to be damaged. Alternatively, the process **301** may attempt to archive portions of the recording medium marked with an "error" indicator. This may give the process **301** another attempt at archiving the portion. For example, after stopping the playback and archival process **301** at step **361** (e.g., by ejecting the recording medium and/or receiving a command via a user interface), a user may have attempted to repair the recording medium and/or may have procured a different copy of the recording medium. As such, the portion of the recording medium that caused an error during a previous read attempt may be successfully read in a subsequent attempt.

In an alternative embodiment, the media player **101** may access a pre-existing DAM, provided by a metadata provider **132** or other party who may aggregate DAM information, and may use the pre-existing DAM to speed up archival of the recording medium **103** and/or to compare the data on the recording medium **103** to that in the pre-existing DAM. In an alternative embodiment, the media player **101** may transmit the locally generated DAM to a metadata provider **132** or other party who may aggregate DAM information.

FIG. **4** is a flow chart of one embodiment of a process **400** for acquiring metadata relating to a content item. At step **410**, the process **400** may be initialized as described above.

At step **420**, a content item may be archived. The archiving of step **420** may be performed using, for instance, the system **100** of FIG. **1** and/or using a process or processes, such as the processes **200**, **201**, and/or **300** described above.

At step **430**, a content item identifier may be generated. The content item identifier may be a title of the content item, a recording medium identifier, a table of contents of the content item, a partial or complete DAM, a hash value comprising a combination of identifiers, or the like. The identifier may be generated before completion of the archival of the content item. For example, the content item identifier may be generated (and the metadata may be retrieved) upon detecting insertion of the recording medium.

At step **440**, a request for metadata may be generated and submitted to a metadata provider. The request submitted at step **440** may include the content item identifier generated at step **430**. Submitting the request may comprise transmitting the request to a metadata provider over a network. As described above, a metadata provider may receive the request, and, using the content item identifier generated at step **430**, may access (e.g., look up) metadata related to the content item in a content item database or other data store.

The metadata provider may transmit a response to the request of step **430**. The response may include metadata relating to the content item. The response may be received at step **450**. At step **460**, the metadata may be stored in a storage medium (e.g., in the storage medium **112** of FIG. **1**). The metadata may be associated with the content item in the storage medium (e.g., via a database association, a structural association, or the like).

The metadata associated with the content item may be used to categorize the content item according to a content item genre, rating, or the like. Similarly, the metadata may be searchable. This may allow a user to perform detailed searches for particular types of content items. For example, a user may search for all content items in the "action" genre, having a "PG-13" rating or lower, and so on. Similarly, the metadata may be used in content item listings or other display interfaces. For example, a set (e.g., list) of content items may be presented by displaying metadata associated with each content item in the set. For instance, a set of DVD movie content items may be presented by displaying graphical metadata (e.g., DVD movie cover) and title metadata of the respective content items.

FIG. **5** depicts a media content graph comprising a plurality of media content segments interconnected by a plurality of branches. The graph **500** may correspond to media content stored on a recording medium, such as the recording medium **103** of FIG. **1**. The graph may include one or more media data segments (e.g., **501**, **505**, **507**, **510**, **515**, and **517**) interconnected by one or more branches (e.g., **503** and **513**). Each of the segments **501**, **505**, **507**, **510**, **515**, and/or **517** may correspond to a linked series of data on a recording medium, such as a series of linked cells on a DVD disc. The graph **500** may be used to indicate which portions of a recording medium are valid (e.g., the unmarked segments **501**, **507**, **510**, and **517**) and which are invalid (e.g., which portions of the recording medium contain intentionally invalid data, such as segments **505** and **515**). The graph **500** may be used by various components of a media player (e.g., the archival component **105** and/or playback compo-

nent **106** of FIG. **1**) to determine which portions of a recording medium should be archived and/or played back.

The segment **501** may represent a first segment of the media content on a recording medium (e.g., the "first-play" program chain of a DVD recording medium). A media analysis component may access the first segment **501** and walk the segment (e.g., sequentially access linked data segments) until a terminal point **503** is reached. "Walking" the recording medium may include traversing linked sectors and/or cells within a particular segment of the recording medium (e.g., segment **501**) as quickly as possible. In some embodiments, during walking, any media content read from the recording medium may be discarded (e.g., video data read from a DVD disc may be ignored) to allow the walk operation to complete as quickly as possible. Alternatively, the media content may be made available to an archival component.

In the FIG. **5** example, the media analysis component may walk the first segment **501** to a branch **503**. The branch **503** may include a plurality of outbound links (e.g., links to other data segments on the recording medium). The branch **503** includes outbound links **505**, **507**, and **510**. As discussed above, a media analysis component may determine whether one or more of the branches is valid by examining a menu item associated with the branch (e.g., by examining the menu item which would cause a standard DVD player to follow the respective branches). If a menu item associated with a branch is determined to be a "dummy" menu item, the walker process may mark the branch as "bad," and the content on the recording medium associated with the branch may be ignored. A menu item may be identified as "bad," if it would not be visible on a display, if it would be displayed for a very short period, and so on. The media analysis component may use various mechanisms for determining whether a menu item is not selectable (e.g., invalid). The particular set of mechanisms used to detect invalid menu items may depend upon the nature of the obfuscation scheme in use on the recording medium and may change over time (e.g., as the scheme changes). Examples include, but are not limited to determining that the menu item would be displayed outside of the visible area of the display, would be displayed as an "invisible" element on the display, would have a size below a threshold, is not selectable, is displayed for less than a threshold number of frames, and the like.

In the FIG. **5** example, the menu item associated with the segment **505** is determined to be an invalid menu item and, as such, a portion of the recording medium associated therewith is marked as invalid. This portion of the recording medium may be ignored by the walker process and/or by an archival or playback component. The segments **507** and **510** may be considered valid segments (e.g., the menu item associated with the segments **507** and **510** may be considered to be valid menu items). As such, the portions of the recording medium corresponding to the segments **507** and **510** may be marked as "valid," added to a list of valid portions of the recording medium, added to a graph of valid content on the recording medium, or the like. The media analysis component may walk each of the valid segments **507** and **510** in turn.

In some embodiments, the media analysis component may maintain a state of the graph **500** by storing a current state of the recording medium walker (e.g., a segment address of the branch **503** on the recording medium) and the segment address of each of the valid outbound links. In the FIG. **5** example, the media analysis component may store its current state (e.g., the address of the branch point **503**) and the state after following each of the valid menu items (e.g., the address of the segments **507** and **510**) in a data structure ("media walk data structure"). The media walk data structure may be a list and/or a stack-type data structure. The media analysis component may continue walking the recording medium by recursively popping and walking recording medium states from the media walk data structure.

In walking the segment **507**, the media analysis component may reach a non-branching terminal point **509** (e.g., an end of the segment **507**). Upon reaching the terminal point **509**, the media analysis component may remove (e.g., pop) the state corresponding to the segment **507** from the media walk data structure, return to the state recorded at the branch **503**, and continue walking the recording medium at the next state in the media walk data structure. If the data encountered within the segment **507** is considered to be valid (e.g., does not contain excessive errors, loops, or the like), the segment **507** may be marked as "valid" and/or included in a list of valid portions of the recording medium, in a graph of the valid portions of the recording medium, or the like.

The next state in the media walk data structure may be the segment **510**. The media analysis component may walk the segment **510** until the branch **513** is reached. The branch terminal point **513** may include links to two (2) outbound segments on the recording medium, **515** and **517**. The menu items of each of the outbound segments **515** and **517** may appear to be valid. As such, the media analysis component may include the states of the segments **515** and **517** in the media walk data structure.

The media analysis component may determine that the segment **515** includes invalid data (e.g., intentionally bad data). However, the bad data of segment **515** may be linked to a menu item identified as a "valid." As discussed above, an obfuscation scheme may use various mechanisms for placing invalid menu items on the recording medium. The mechanisms used by the scheme may change over time. As such, the media analysis component may fail to identify certain invalid menu items, such as the menu item associated with the data segment **515**.

The media analysis component may detect intentionally invalid data on the recording medium in various different ways which may include, but are not limited to detecting cyclic data in the segment **515** (e.g., encountering the same data segment (cell) more than once), detecting an infinite still frame in the segment **515**, detecting more than a threshold number of read errors in a portion (e.g., cell) of the segment **515**, and the like. If invalid data is detected, the portion of the recording medium corresponding to the segment **515** may be marked as "invalid," and the media analysis component may remove the segment **515** from the media walk data structure. The media analysis component may then continue walking the recording medium at the next state in the media walk data structure (e.g., segment **517** of the recording medium). The media analysis component may periodically update its rules for performing the media walk operation using a push or pull from an update server (not shown), from data stored on a recording medium (e.g., the recording medium **103** of FIG. **1**), from a removable storage medium, or another source.

The result of the media walk operation described above, may be a graph of the recording medium. The graph may include valid portions of the recording medium. For example, the graph may include a set of segments of the recording medium (e.g., **501**, **507**, **510**, and so on) interconnected by one or more branches on the recording medium (e.g., **503**, **513**). The graph may include indications of which portions of the recording medium contain valid data (e.g., valid media content) and which do not. Alternatively, the

data structure may only contain portions of the recording medium considered to be "valid." As such, in some embodiments, the "bad" portions of the recording medium may be removed from the data structure. Similarly, in some embodiments, the portions of the recording medium identified as "valid" (e.g., containing valid media content) may be placed in a list (e.g., valid data list). Like the graph, the list of valid portions of the recording medium may be used by an archival and/or playback component to quickly identify which portions of a recording medium should be archived and/or played back.

A playback and/or archival component may use the graph **500** (or other data structure) to avoid intentionally invalid data by avoiding segments on the recording medium marked as "bad" and/or restricting archival and/or playback of the portions of the recording medium which have been confirmed as comprising valid media content. Alternatively, the playback and/or archival component may read a recording medium according to a graph or other data structure that includes only valid portions of the recording medium to thereby avoid any invalid portions of the recording medium.

FIG. **6** is a flow chart of a process **600** for determining the structure of media content stored on a recording medium. At step **610**, the process **600** may be initialized as described above in conjunction with FIGS. **2-4**.

At step **620**, a media analysis instruction may be received. In some embodiments, the instruction of step **620** may be generated upon detection of the insertion of a recording medium into a media reader and/or a user selection of a "play and save" user interface input. In other embodiments, the instruction may be produced responsive to a read and/or archiving error detected by an archival component and/or playback component of a media player.

At step **630**, an initial location within the recording medium may be added to a media walk data structure. The media walk data structure may include a set of locations (e.g., addresses) within the recording medium believed to comprise valid media content (e.g., a set of states within the recording medium). In some embodiments, the media walk data structure may be a stack-like data structure and, at step **630**, the initial location within the recording medium may be pushed thereon.

The initial location may be a starting location within the recording medium (e.g., a "first-play" program chain of a DVD, a beginning portion of an audio CD, or the like). Alternatively, the initial position may be a last known good playback and/or archival position on the recording medium. This may allow the process **600** to generate a partial analysis of the recording medium, which may complete more quickly than a full analysis of the recording medium.

At step **635**, the process **600** may determine whether the media walk data structure contains any additional media walk states. Of course, on the first iteration of the step **635** (e.g., after adding the initial location to the walk list), the walk list will include at least one state. If a state exists in the media walk data structure, the flow may continue at step **640**; otherwise, the flow may terminate at step **680**.

At step **640**, the next position within the recording medium may be accessed (e.g., popped from the media walk data structure stack) and the process **600** may "walk" the media data at the popped location. As discussed above, "walking" a recording medium may include reading linked data segments (e.g., cells) from the recording medium as if the process **600** were a standard media player (e.g., a standard DVD player). Accordingly, at step **640**, the process **600** may sequentially read linked data segments from the recording medium and/or execute virtual machine instructions as if the process were a standard media player. For example, if the recording medium were a DVD, the process **600** may comprise a DVD virtual machine emulator to emulate the operation of a standard DVD player (e.g., read data from the DVD and/or execute instructions read from the DVD as would a standard DVD player).

In some embodiments, media data (e.g., video data) read during the walking of step **640** may be discarded to speed up the analysis of the recording medium. In this way, the process **600** may progress through the recording medium as quickly as possible. Alternatively, the walking may be performed in conjunction with archival of the recording medium and, as such, media data read during the walking of step **640** may be stored in a storage medium and/or made available to an archival component, such as the archival component **105** of FIG. **1**.

At step **650**, the process **600** may determine whether the media content walked at step **640** is valid. As discussed above, in some cases, intentionally bad data may be placed on a recording medium to prevent straight-through archival of the recording medium. Some of this bad data may be avoided by analyzing links to various segments on the recording medium (e.g., various mechanisms for avoiding links to intentionally bad data are described below in conjunction with step **673**). However, in some cases, not all of the bad data may be avoided in this way. For example, an obfuscation scheme may develop new ways of placing invalid menu items on a recording medium that are more difficult to detect.

At step **650**, the process **600** may detect invalid data on the recording medium. The detecting of step **650** may be done using various different detection mechanisms, which may include, but are not limited to detecting cyclic and/or looped data (e.g., encountering the same data (cell) more than once), detecting an infinite and/or excessively long still frame in the data, detecting more than a threshold number of read errors in a portion of the data (e.g., in a particular cell), and so on. If the data is valid, the flow may continue to step **660**; otherwise, the flow may continue to step **655**.

At step **655**, the location (e.g., segment on the recording medium) of the invalid data may be so marked and/or removed from the media walk data structure. Similarly, if the process **600** is maintaining a graph or list structure comprising the valid portions of the recording medium, the segment may be removed therefrom. This may prevent an archival and/or playback component from attempting to access the invalid portion of the recording medium.

At step **660**, the walk of step **640** may reach a terminal point. If the terminal point is a branch, the flow may continue at step **670**; otherwise, the flow may continue at step **635** where the next state in the media walk data structure may be walked.

At step **670**, each possible branch may be evaluated to determine whether the branch links to valid data on the recording medium (e.g., whether the branch is an "actual" branch or a "dummy branch" included as part of an obfuscation scheme). If one or more branches remain to be evaluated the flow may continue at step **673**; otherwise, the flow may continue at step **635** where a next state in the media walk data structure may be walked.

At step **673**, the process **600** may determine whether a branch links to valid data. As discussed above, the process **600** may use various mechanisms to make this determination including, but not limited to determining whether a menu item associated with the branch would be visible on a display, comparing the size of the menu item to a size threshold, determining whether the menu item is invisible on

the display (e.g., comparing the color of the menu item to a back ground color), comparing the number of frames the menu item is to be displayed to a threshold, determining whether the option is selectable, and so on. If, at step **673**, the menu item of the branch indicates that branch is valid (e.g., the menu item appears to be a valid, selectable menu item), the flow may continue at step **675**; otherwise, the flow may continue at step **679**.

At step **675**, the branch may be added to the media walk data structure (e.g., pushed onto the media walk stack), and the flow may continue at step **670** where the next branch may be evaluated.

At step **679**, the branch may be removed from media walk data structure (or simply not added thereto). In addition, in some embodiments, the branch may be marked as a "bad branch" and/or the portion of the recording medium corresponding to the branch may be marked as "invalid," so that subsequent accesses to the branch and/or data segment by the process **600**, an archival component, and/or playback component may be avoided. Similarly, if the process **600** is maintaining a graph or other data structure comprising valid portions of the recording medium, the portion of the recording medium corresponding to the invalid branch may be removed therefrom. The flow may continue at step **670** where the next branch may be evaluated.

By emulating the operation of a standard media player, the process **600** may traverse all of the valid portions of a recording medium. The indicators of which portions of the recording medium contain valid media data (e.g., which branches and corresponding data segments are valid) may be stored in a graph data structure (e.g., as shown in FIG. **5**), a list of valid portions of the recording medium, or other structure (e.g., a stack, vector, or the like). The graph or other data structure may be used by other components of a media player to avoid invalid data intentionally placed on the recording medium and/or to distinguish between read errors and/or read timeouts due to recording medium damage and those caused by intentionally placed bad data.

The above description provides numerous specific details for a thorough understanding of the embodiments described herein. However, those of skill in the art will recognize that one or more of the specific details may be omitted, or other processes, components, or materials may be used. In some cases, operations are not shown or described in detail.

Furthermore, the described features, operations, or characteristics may be combined in any suitable manner in one or more embodiments. It will also be readily understood that the order of the steps or actions of the processes described in connection with the embodiments disclosed may be changed. Thus, any order in the drawings or Detailed Description is for illustrative purposes only and is not meant to imply a required order, unless specified to require an order.

Embodiments may include various steps, which may be embodied in machine-executable instructions to be executed by a general-purpose or special-purpose computer (or other electronic device). Alternatively, the steps may be performed by hardware components that include specific logic for performing the steps, or by a combination of hardware, software, and/or firmware.

Embodiments may also be provided as a computer program product, including a computer-readable medium having stored instructions thereon that may be used to program a computer (or other electronic device) to perform processes described herein. The computer-readable medium may include, but is not limited to hard drives, floppy diskettes, optical discs, CD-ROMs, DVD-ROMs, ROMs, RAMs, EPROMs, EEPROMs, magnetic or optical cards, solid-state memory devices, or other types of media/machine-readable medium suitable for storing electronic instructions.

As used herein, a software module or component may include any type of computer instruction or computer executable code located within a memory device. A software module may, for instance, include one or more physical or logical blocks of computer instructions, which may be organized as a routine, program, object, component, data structure, etc., that perform one or more tasks or implements particular abstract data types.

In certain embodiments, a particular software module may include disparate instructions stored in different locations of a memory device, which together implement the described functionality of the module. Indeed, a module may include a single instruction or many instructions, and may be distributed over several different code segments, among different programs, and across several memory devices. Some embodiments may be practiced in a distributed computing environment where tasks are performed by a remote processing device linked through a communications network. In a distributed computing environment, software modules may be located in local and/or remote memory storage devices. In addition, data being tied or rendered together in a database record may be resident in the same memory device, or across several memory devices, and may be linked together in fields of a record in a database across a network.

It will be understood by those having skill in the art that many changes may be made to the details of the above-described embodiments without departing from the underlying principles of this disclosure.

What is claimed is:

1. A media player comprising:

a media reader to read media content from a recording medium inserted into the media reader;

a media analysis component to identify portions of the recording medium as being valid or invalid, wherein the media analysis component identifies the portions of the recording medium as being valid or invalid by executing virtual machine instructions to emulate a media player;

an archival component to store, in a storage medium, media content read from the recording medium by the media reader, the archival component further to generate a data allocation map including a list of portions of the recording medium with respective corresponding status indicators to indicate a status of each portion and to update the data allocation map as portions of the recording medium are accessed, the status indicators including an archived status indicator and an un-archived status indicator; and

a playback component to play back the media content of the recording medium from the storage medium concurrently with the archival component storing the media content,

wherein the archival component is further configured to, after the play back by the playback component from the storage medium of the media content of the recording medium, archive media content of any un-archived portions of the recording medium, based on determining from an un-archived status indicator in the data allocation map that a corresponding portion of the recording medium is an un-archived portion.

2. The media player of claim **1**,

wherein the archival component stores in the storage medium media content read from valid portions of the

recording medium and updates the data allocation map with a valid status indicator corresponding to the valid portions or an invalid status indicator for invalid portions.

3. The media player of claim **2**, wherein the playback component is configured to play back the media content of the valid portions of the recording medium from the storage medium concurrently with the media analysis component identifying the portions of the recording medium and the archival component storing the media content.

4. The media player of claim **2**, wherein the media analysis component evaluates a branch linking to a portion of the recording medium to determine whether the branch is invalid, and wherein the portion of the recording medium to which the branch is linked is not identified as a valid portion of the recording medium if the branch is determined to be invalid.

5. The media player of claim **1**, wherein the recording medium is a DVD disc, and wherein the media analysis component emulates a media player by reading data from the DVD disc and executing DVD virtual machine instructions as a DVD player.

6. The media player of claim **1**, wherein if a read error is encountered by the media reader, the archival component is configured to update the data allocation map to indicate the read error with an error status indicator.

7. The media player of claim **1**, wherein if a timeout is encountered by the media reader, the archival component is configured to update the data allocation map to indicate the timeout with an error status indicator.

8. The media player of claim **1**, wherein the archival component is further configured to, upon the media reader reaching an end of the media content on the recording medium, archive media content of any un-archived portions of the recording medium, based on determining from an un-archived status indicator in the data allocation map that a corresponding portion of the recording medium is an un-archived portion.

9. A method of creating a media archive, comprising:

reading media content from a recording medium inserted into a media reader;

identifying portions of the recording medium as being valid or invalid by executing virtual machine instructions to emulate a media player;

generating a data allocation map including a list of portions of the recording medium with respective corresponding status indicators to indicate a status of each portion of the recording medium

storing media content of the recording medium in a storage medium;

updating the data allocation map as portions of the recording medium are accessed, the status indicators including an archived status indicator for portions of the recording medium for which media content is stored in the storage medium and an un-archived status indicator for portions of the recording medium for which media content has not been stored in the storage medium;

playing back the media content of the recording medium from the storage medium concurrently with the storing the media content; and

upon the media reader reaching an end of the media content on the recording medium:

identifying one or more un-archived portions of the recording medium based on one or more corresponding un-archived status indicator in the data allocation map;

reading media content from the one or more un-archived portions of the recording medium; and

storing in the storage medium the media content of the one or more un-archived portions of the recording medium.

10. The method of claim **9**, further comprising:

wherein the storing the media content of the recording medium in a storage medium comprises storing the valid portions of the recording medium.

11. The method of claim **10**, wherein the playing back the media content of the recording medium from the storage medium comprises playing back the valid portions of the recording medium from the storage medium concurrently with the identifying the portions of the recording medium and the storing the media content.

12. The method of claim **10**, wherein identifying the one or more portions of the recording medium as being valid or invalid comprises evaluating a branch linking to a portion of the recording medium to determine whether the branch is invalid, and wherein, if the branch is determined to be invalid, the portion of the recording medium to which the branch is linked is not identified as a valid portion of the recording medium.

13. The method of claim **10**, wherein the recording medium is a DVD disc, and wherein emulating a media player comprises reading data from the DVD disc and executing DVD virtual machine instructions as a DVD player.

14. The method of claim **9**, wherein if a read error is encountered during the reading the media content, then updating the data allocation map includes indicating the read error with an error status indicator.

15. The method of claim **9**, wherein if a timeout is encountered during the reading the media content, then updating the data allocation map includes indicating the timeout with an error status indicator.

16. A non-transitory computer-readable storage medium comprising instructions, that when executed by a media player, cause the media player to:

read media content from a recording medium inserted into a media reader of the media player;

identify portions of a recording medium as being valid or invalid by executing virtual machine instructions to emulate a media player,

generate a data allocation map including a list of portions of the recording medium with respective corresponding status indicators to indicate a status of each portion of the recording medium

store media content of the recording medium in a storage medium;

update the data allocation map as portions of the recording medium are accessed, the status indicators including an archived status indicator for portions of the recording medium for which media content is stored in the storage medium and an un-archived status indicator for portions of the recording medium for which media content has not been stored in the storage medium;

play back the media content of the recording medium from the storage medium concurrently with the storing the media content;

detect reading the media content reaching an end of the media content on the recording medium; and

upon a detection of the reading the media content reaching the end:

identify one or more un-archived portions of the recording medium based on one or more corresponding un-archived status indicator in the data allocation map;

read media content from the one or more un-archived portions of the recording medium; and

store in the storage medium the media content of the one or more un-archived portions of the recording medium.

17. The non-transitory computer-readable storage medium of claim **16**,

wherein to store the media content of the recording medium in the storage medium comprises storing the valid portions of the recording medium.

18. The non-transitory computer-readable storage medium of claim **17**, wherein the instructions to cause the media player to play back the media content of the recording medium from the storage medium comprise instructions to cause the media player to play back the valid portions of the recording medium from the storage medium concurrently with identifying the portions of the recording medium and the storing the media content.

19. The non-transitory computer-readable storage medium of claim **17**, wherein the instructions that cause the media player to identify the one or more portions of the recording medium as being valid or invalid comprise instructions to evaluate a branch linking to a portion of the recording medium to determine whether the branch is invalid, wherein, if the branch is determined to be invalid, the portion of the recording medium to which the branch is linked is not identified as a valid portion of the recording medium.

20. The non-transitory computer-readable storage medium of claim **16**, wherein if a read error is encountered during the reading the media content, then updating the data allocation map includes indicating the read error with an error status indicator.

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