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**Systems and Methods for Enhanced Trick-Play Functions**

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2013203314 10 Apr 2013

ABSTRACT

The present invention is directed to a method comprising the steps of displaying a plurality of program listings; identifying a program listing for which a rewind stream or a forward stream is available by an indicator; and displaying the program listing with the indicator.

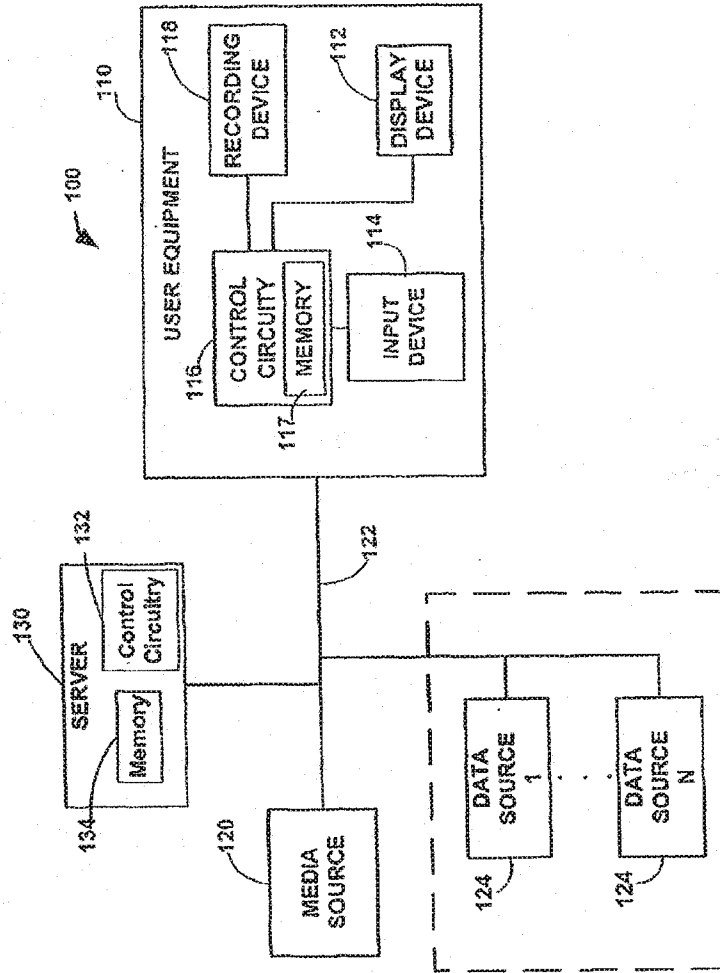


FIG. 1

SYSTEMS AND METHODS FOR ENHANCED TRICK-PLAY FUNCTIONS

Background of the Invention

[0001] This invention is directed to systems and methods  
5 for trick-play functions in video or audio entertainment  
systems.

[0002] Mere reference to background art herein should not  
be construed as an admission that such art constitutes common  
general knowledge in relation to the invention.

10 [0003] Interactive media guidance applications, such as  
interactive television program guides, are well known in the  
art. Some interactive media guidance applications provide  
video entertainment device users with the ability to perform  
"trick-play" functions upon video. Such trick-play functions  
15 include pause, rewind, and fast-forward. The interactive  
media guidance applications cache video programs that are  
transmitted over a network or transmission system (e.g.,  
satellite, cable, or off-the-air) to allow users to trick-  
play through the video programs. To provide trick-play  
20 functions, these systems may begin caching video when the  
user tunes to the program, which may be in progress. As a  
result, users of such systems can rewind to the point in time  
when they first tuned to the program, but not to any prior  
point in time.

25 [0004] Accordingly, it would be desirable to provide  
systems and methods for trick-play functions by which the  
user may rewind a video to a time prior to when the user  
first started viewing the video and fast-forward to a point  
beyond where the real-time transmission is presently  
30 streaming.

Summary of the Invention

[0005] According to one aspect of the invention, there is  
35 provided a method comprising:

2013203314 10 Apr 2013

2013203314 10 Apr 2013

displaying a plurality of program listings;  
identifying a program listing for which a rewind stream  
or a forward stream is available by an indicator; and  
displaying the program listing with the indicator.

5 [0006] The indicator may be an icon, shading, or coloring.

[0007] The method may further comprise displaying the  
plurality of program listings in a grid.

[0008] The method may further comprise:

10 receiving from a server, time information for a program  
listing for which a rewind stream is available; and

receiving from the server, time information for a  
program listing for which a forward stream is available.

[0009] The method may further comprise determining whether  
a server has stored a program associated with the program  
15 listing.

[0009a] The indicator may indicate that a forward stream is  
available.

[0009b] The indicator may indicate that a rewind stream is  
available.

20 [0009c] The method may further comprise:

determining that a user has a sufficient interest in a  
non-on-demand video program associated with a program  
listing;

25 sending a request for a rewind stream, in response to  
determining that the user has a sufficient interest in the  
non-on-demand video program; and

receiving the rewind stream, in response to sending the  
request for the rewind stream.

[0009d] The method may further comprise:

30 determining that a user has a sufficient interest in a  
non-on-demand video program associated with a program  
listing;

35 sending a request for a forward stream, in response to  
determining that the user has a sufficient interest in the  
non-on-demand video program; and

2013203314 10 Apr 2013

receiving the forward stream, in response to sending the request for the forward stream.

[0009e] The method may further comprise:

accessing the non-on-demand video after the start of the transmission of the video, wherein the non-on-demand video is associated with the program listing displayed with an indicator;

receiving the rewind stream comprising a first frame corresponding to a time when the video was accessed and a last frame corresponding to the start of the video, wherein the rewind stream when, played back, displays the video content in substantially continuous reverse order without skipping any video frames from the first frame of the rewind stream toward the last frame of the rewind stream;

caching the rewind stream in a rewind buffer; rewinding the video through the rewind buffer; and playing back the video from the rewind buffer.

[0009f] According to another aspect of the invention, there is provided a system comprising:

means for displaying a plurality of program listings; means for identifying a programming listing for which a rewind stream or a forward stream is available by an indicator; and

means for displaying the program listing with the indicator.

[0009g] The system may further comprise means for displaying the plurality of program listings in a grid.

[0009h] The system may further comprise:

means for receiving from a server, time information for a program listing in the grid for which a rewind stream is available; and

means for receiving from the server, time information for a program listing in the grid for which a forward stream is available.

2013203314 10 Apr 2013

[0009i] The system may further comprise means for determining whether a server has stored a program associated with the program listing.

[0009j] The system may further comprise:

5 means for determining that a user has a sufficient interest in a non-on-demand video program associated with a program listing;

10 means for sending a request for a rewind stream, in response to determining that the user has a sufficient interest in the non-on-demand video program; and

means for receiving the rewind stream, in response to sending the request for the rewind stream.

[0009k] The system may further comprise:

15 means for determining that a user has a sufficient interest in a non-on-demand video program associated with a program listing;

means for sending a request for a forward stream, in response to determining that the user has a sufficient interest in the non-on-demand video program; and

20 means for receiving the forward stream, in response to sending the request for the forward stream.

[0009l] The system may further comprise:

25 means for accessing the non-on-demand video after the start of the transmission of the video, wherein the non-on-demand video is associated with the program listing displayed with an indicator;

30 means for receiving the rewind stream comprising a first frame corresponding to a time when the video was accessed and a last frame corresponding to the start of the video, wherein the rewind stream when, played back, displays the video content in substantially continuous reverse order without skipping any video frames from the first frame of the rewind stream toward the last frame of the rewind stream;

means for caching the rewind stream in a rewind buffer;

means for rewinding the video through the rewind buffer;  
and

means for playing back the video from the rewind buffer.

[0009m] Any of the features described herein can be  
5 combined in any combination with any one or more of the other  
features described herein within the scope of the invention.

Brief Description of the Drawings

[0010] The above and other features of the present  
10 invention, its nature and various advantages will be more  
apparent upon consideration of the following detailed  
description, taken in conjunction with the accompanying  
drawings in which:

[0011] FIG. 1 is a diagram of an illustrative interactive  
15 media system in accordance with one embodiment of the present  
invention;

[0012] FIG. 2 shows an illustrative data structure for  
buffers in accordance with one embodiment of the present  
invention;

20 [0013] FIG. 3 shows another illustrative data structure  
for buffers in accordance with one embodiment of the present  
invention;

[0014] FIG. 4 shows an illustrative display having a  
transport control bar in accordance with one embodiment of  
25 the present invention;

[0015] FIG. 5 shows another illustrative display having a  
transport control bar in accordance with one embodiment of  
the present invention;

[0016] FIG. 6 shows still another illustrative display  
30 having transport control bar in accordance with one  
embodiment of the present invention;

2013203314 10 Apr 2013



[0017] FIG. 7 shows an illustrative display screen having a program grid in accordance with one embodiment of the present invention;

[0018] FIG. 8 shows a flow chart of an illustrative process for rewinding a video in accordance with one embodiment of the present invention;

[0019] FIG. 9 shows a flow chart of an illustrative process for fast-forwarding a video in accordance with one embodiment of the present invention;

[0020] FIG. 10 shows a flow chart of an illustrative process for providing a video stream to a user's equipment in accordance with one embodiment of the present invention; and

[0021] FIG. 11 shows a flow chart of an illustrative process for playing back video from rewind and/or forward buffers in accordance with one embodiment of the present invention.

#### Detailed Description

[0022] FIG. 1 shows illustrative interactive media system 100 in accordance with one embodiment of the invention. User equipment 110 receives media in the form of signals from media source 120 over communications path 122. In practice there may be multiple media sources 120 and user equipment 110, but only one of each has been shown in FIG. 1 to avoid over-complicating the drawing.

[0023] Media source 120 may be any suitable media source such as, for example, a cable system headend, satellite media distribution facility, media broadcast facility, internet protocol television (IPTV) headend, on-demand server (e.g., VOD server), website, game service provider (e.g., for online gaming), or any

other suitable facility or system for originating or distributing media. Media source 120 may be configured to transmit signals over any suitable communications path 122 including, for example, a satellite path, a

5 fiber-optic path, a cable path, an Internet path, or any other suitable wired or wireless path. The signals may carry any suitable media such as, for example, television programs, games, music, news, web services, video, or any other suitable media. In some

10 embodiments, media source 120 may include control circuitry for executing the instructions of a trick-play client or an interactive media guidance application such as, for example an online interactive media guidance application.

15 [0024] User equipment 110 may include any equipment suitable for providing an interactive media experience. User equipment 110 may include television equipment such as a television, set-top box, recording device, video player, user input device (e.g., remote control,

20 keyboard, mouse, touch pad, touch screen or voice recognition interface), or any other device suitable for providing an interactive media experience. For example, user equipment 110 may include a DCT 2000, 2500, 5100, 6208 or 6412 set-top box provided by

25 Motorola, Inc. In some embodiments, user equipment 110 may include computer equipment, such as a personal computer with a television card (PCTV). In some embodiments, user equipment 110 may include a fixed electronic device such as, for example, a gaming system

30 (e.g., X-Box, PlayStation, or GameCube) or a portable electronic device, such as a portable DVD player, a portable gaming device, a cellular telephone, a PDA, a

music player (e.g., MP3 player), or any other suitable fixed or portable device.

[0025] In the example of FIG. 1, user equipment 110 includes at least control circuitry 116, display device 5 112, user input device 114, and recording device 118 which may be implemented as separate devices or as a single device. A trick-play client may be implemented on user equipment 110 to provide trick-play functions to the user for media displayed on display device 112. 10 In some embodiments, the trick-play client is part of an interactive media guidance application, such as an interactive television program guide. For purposes of clarity, and not by way of limitation, the following embodiments will be described as provided by a trick- 15 play client.

[0026] Display device 112 may be any suitable device such as, for example, a television monitor, a computer monitor, or a display incorporated in user 20 equipment 110 (e.g., a cellular telephone or portable music player display). Display device 112 displays the media transmitted by media source 120 over path 122, and the displays of the trick-play client. Display device 112 may also be configured to provide for the output of audio.

25 [0027] Recording device 118 may be a personal video recorder (PVR), digital video recorder (DVR), video cassette recorder (VCR), DVD-recorder, or any other suitable video recorder. Recording device 118 may include one or more tuners. The trick-play client 30 directs recording device 118 to cache the rewind and forward streams from server 130.

[0028] Control circuitry 116 is adapted to receive user inputs from input device 114 and execute the

instructions of the trick-play client. Control circuitry 116 may include one or more tuners (e.g., analog or digital tuners), encoders and decoders (e.g., MPEG decoders), processors (e.g., Motorola 68000 family processors), memory 117 (i.e., RAM and hard disks), communications circuitry (e.g., cable modem circuitry), input/output circuitry (e.g., graphics circuitry), connections to the various devices of user equipment 110, and any other suitable component for providing analog or digital media programming, program recording, and interactive media guidance features. In some embodiments, control circuitry 116 may be included as part of one of the devices of user equipment 110 such as, for example, part of display 112 or any other device (e.g., a set-top box, television and video player).

[0029] In some embodiments, the trick-play client may provide features to the user with a client/server approach. There may be one server for each instance of user equipment 110, one for multiple instances of user equipment 110, or a single server may serve as a proxy for each instance of user equipment 110.

[0030] Any suitable number of users may have equipment, such as user equipment 110, connected to media source 120 and data sources 124. But for the clarity of the figure, the equipment of only a single user is shown. The equipment of the plurality of users may be connected to media source 120 and data source 124 using a cable television network, a satellite television network, a local area network (LAN), a wireless network, the Internet, or any other suitable means. In some embodiments, the equipment of

the plurality of users may be connected to each other using any suitable means.

[0031] User equipment 110 may receive interactive media guidance application data from one or more data sources 124. Data sources 124 may provide data for a particular type of media or for a particular application. For example, one data source 124 may provide data for non-on-demand media (e.g., non-pay and pay-per-view programs), and another may provide data for on-demand media (e.g., VOD programs). Or, for example, a single data source may provide both of these types of data. For example, one data source 124 may provide data for an interactive television program guide. Another data source 124 may, for example, provide data for another interactive application (e.g., a home shopping application). In some embodiments, data sources 124 may provide data to the trick-play client using a client/server approach. There may be one server per data source, one for all sources or, in some embodiments, a single server may communicate as a proxy between user equipment 110 and various data sources 124. In some embodiments, data sources 124 may provide data as an online interactive media guidance application. In such embodiments, data source 124 may include control circuitry for executing the instructions of the online media guidance application.

[0032] FIG. 1 shows media source 120 and data sources 124 as separate elements. In practice, their functionality may be combined and provided from a single system at a single facility, or multiple systems at multiple facilities. For example, one media source 120 and data source 124 may be combined to provide VOD content and associated VOD data.

[0033] Illustrative interactive television system 100 includes server 130. Server 130 includes control circuitry 132 and memory 134 for executing, for example, operations requested by media source 120 or user equipment 110 (e.g., providing a cached video to the trick-play client). Control circuitry 132 may include one or more tuners, processors, encoders/decoders, communications circuitry, and I/O circuitry connected to the various devices of interactive television system 100, or any other suitable component. Control circuitry 132 may access video or other media provided by media source 120 in any suitable manner, for example by directing a tuner to tune to the channel transmitted by media source 120. As another example, server 130 may access the video directly, for example via an internet protocol connection (e.g., file transfer protocol or DOCSIS QAM stream) to media source 120.

[0034] Server 130 may be incorporated in media source 120 (e.g., at the head-end of a cable plant), data source 124, a VOD server (not shown), user equipment 110 (e.g., as a second recording device, or a hard drive on a home computer), an Internet server, or any other suitable device. Alternatively, server 130 may be a stand alone device (e.g., a commercial network recording device, or a DVR device in a home or neighborhood network). In some embodiments, all media provided by media source 120 may first be transmitted to server 130, which may subsequently transmit the media to user equipment 110. In such embodiments, the server may record (in systems where user-initiated server-based recording is provided) or cache the media as it is received, and subsequently or simultaneously

transmit the media to the user's equipment. In other  
embodiments, the media source may simultaneously  
provide media both to the server and to the user's  
equipment. In such embodiments, the server may only  
5 provide rewind and/or forward streams of the media that  
is has recorded or cached to the user's equipment in  
response to a request by the trick-play client. In  
some embodiments, the server may cache or record videos  
before they are provided to users by media source 120.

10 [0035] Server 130 may receive instructions from user  
equipment 110 or media source 120 (or any other device  
of interactive media system 100) to perform suitable  
operations. Such operations may include, for example,  
recording or caching some or all of the videos that are  
15 transmitted by media source 120. In some embodiments,  
server 130 may cache every video that is transmitted by  
media source 120. In some embodiments, server 130 may  
only cache particular videos (e.g., particular  
broadcast programs) or particular channels (e.g., user  
20 favorite channels). The user's equipment or the media  
source may identify a particular video in any suitable  
manner (e.g., from the channel map and the program map  
table of a QAM stream, or a program identifier), and  
communicate a request to control circuitry 132 to  
25 record or cache the video in memory 134. In some  
embodiments, users may record videos on server 130. In  
such embodiments, server 130 may use the recorded video  
(which may have been recorded for users other than the  
one using the enhanced rewind functionality) as  
30 "cached" video for the rewind and/or forward stream.

[0036] The trick-play client, the media source, or  
the server may select, based on any suitable criteria,  
the videos that the server records or caches and for

which the enhanced rewind and fast-forward functionality of the present invention is available. Such criteria may include, for example, a user's viewing history, the programs or channels that a user typically watches, records, or sets reminders for, user interests as identified by a user profile (e.g., a profile established by asking the user a series of questions). In some embodiments, the criteria may include identifying the programs that the user watches while another program is recorded, the two or more simultaneously transmitted programs among which the user switches, or the programs that the user starts watching after the beginning of the program. If the server has limited memory capabilities, or if the user is allotted a small amount of server memory, the trick-play client may be more discriminating in the selection of videos that the server records or caches for the user.

[0037] Other criteria for selecting the videos for which the enhanced rewind and fast-forward functionality is available may include the viewing histories or user profiles of some or all of the users of the interactive media system, the popular programs of some or all of the users, or any other criteria derived from more than one user or from a family of users of the interactive media system. As another example, only videos provided by preferred media providers (e.g., providers who pay a fee) may be recorded or cached on the server. Such videos may be identified to users as "provided with enhanced trick play," for example, letting users know that they may rewind, potentially to the beginning of the video even if they joined the video after the video began. In



some embodiments, a channel may be identified as "provided with enhanced trick play." The rewind buffer length may be sufficient to allow the user (after some time) to rewind to a point prior to the beginning of the program (e.g., two or three hours, or to yesterday's videos).

[0038] Recorded and cached videos are stored by server 130 in memory 134. Memory 134 may be any suitable memory for recording or caching video such as, for example, one or more hard-drive arrays, hard discs, server arrays, RAM, SRAM, DRAM, ROM, flash memory, or any other suitable memory. In some embodiments, memory 134 may store instructions from control circuitry 132, user equipment 110, media source 120, or any other device of interactive media system 100 related to recorded or cached video. Such instructions may include, for example, how long to keep the video in memory, which users have access to the video (e.g., in a tier-based system), or any other suitable instruction. In the example of FIG. 1, memory 134 is shown as a component of server 130, but in other embodiments, memory 134 may be a stand-alone component.

[0039] When a user of user equipment 110 accesses a non-on-demand video (such as, for example, by tuning to a channel), the trick-play client may automatically direct recording device 118 of user equipment 110 to cache the video in one or more buffers. In addition, the trick-play client may send a request to server 130 for a rewind stream that includes the portions of the video that were transmitted before the user first started viewing the video.

[0040] In some embodiments, the trick-play client may also send a request to server 130 for a forward

stream that includes the portions of the video that the  
trick-play client has not yet cached. The trick-play  
client may first determine whether the entire video is  
cached or recorded by server 130 before requesting a  
5 forward stream. Alternatively, the trick-play client  
may systematically request the forward stream and wait  
for a response from server 130 regarding whether the  
forward stream portions of the video are available.

[0041] The trick-play client may request the rewind  
10 and/or forward streams at any suitable time including,  
for example, as soon as the user starts viewing a video  
(e.g., tunes to a channel), after a given amount of  
time (e.g., 1 minute or 5 minutes), in response to a  
trick-play request from the user (e.g., pause or  
15 rewind), or at any other suitable time.

[0042] In response to receiving the requests for the  
rewind and/or forward streams, server 130 may generate  
and transmit rewind and/or forward streams to user  
equipment 110, if they are available. For example, if  
20 the trick-play client requests both rewind and forward  
streams for a sporting event that is broadcast live,  
server 130 may generate and transmit only the rewind  
stream because the server has not cached or recorded  
the entire sporting event. The forward stream, if  
25 provided to user equipment 110, may include the full  
feature video (e.g., without skipping any frames) and  
may be transmitted at a speed that is faster than the  
real-time video is transmitted (e.g., 2x faster). The  
forward stream therefore may require more bandwidth  
30 than the real-time video. Similarly, the rewind stream  
may include the full feature video (e.g., without  
skipping any frames) and may be transmitted at a speed  
that is faster than real-time.

[0043] Server 130 may provide the rewind and forward streams to user equipment 110 using any suitable transmission scheme (e.g., MPEG-2 QAM stream or DOCSIS QAM stream). For example, the rewind and forward  
5 streams may each be added as separate programs in the live QAM stream used to transmit the video (e.g., the rewind stream is placed in a first PID (packet identifier), and the forward stream is placed in a second PID, where the PIDs are in the QAM stream). As  
10 another example, the rewind and forward streams may both be added as a single program in the live QAM stream (e.g., a single PMT (program map table) PID may identify both the rewind video and audio, and the forward video and audio as well as the primary real-  
15 time video and audio). As still another example, the server may generate one or more new QAM streams each containing one of the rewind and forward streams.

[0044] The video of the rewind stream may be provided in any suitable manner such as, for example,  
20 reverse order bitwise (e.g., as if the user is rewinding from the moment the buffers were created), reverse order by block, reverse order by packet, or by randomly filling in bits of data that are missing (e.g., a bit torrent approach). For approaches other  
25 than the reverse order bitwise, the rewind functionality is only available once the video cached by the trick-play client is sufficiently continuous to support playback.

[0045] The trick-play client may direct recording  
30 device 118 to cache the rewind and/or forward streams provided by server 130 in one or more buffers. FIG. 2 shows an illustrative data structure for the one or more buffers. Data structure 200 includes table 210

and buffers 222 and 224. Table 210 may be stored in recording device 118 (e.g., in memory 220), in memory of control circuitry 116 (e.g., RAM), or in any other memory of user equipment 110. Buffers 222 and 224 may  
5 be stored in memory 220 of recording device 118 (e.g., on a hard drive). Table 210 includes a column for streams of the video (e.g., rewind and forward streams) and a column for pointers linking the streams to their respective buffers. In response to receiving the  
10 rewind/and or forward streams from server 130, the trick-play client creates rows 212 and 214 for the streams in table 210.

[0046] The video provided by the rewind stream is cached in rewind buffer 222. The current frame cached  
15 in the rewind buffer,  $F_{i-r}$ , is identified by pointer 232. Rewind buffer 222 begins with frame  $F_n$ , the frame that was displayed when the user started viewing the video, and ends with frame  $F_0$ , which is the first frame of the video. The rewind buffer is filled  
20 backwards substantially continuously from frame  $F_n$  to frame  $F_0$  (e.g., in reverse order bitwise) with the video of the rewind stream. Similarly, the video provided by the forward stream is cached in forward buffer 224. The current frame in the forward buffer,  $F_{i-f}$ , is  
25 identified by pointer 234. Forward buffer 224 begins with frame  $F_n$  and ends with frame  $F_y$ , which is the last frame of the video. The trick-play client may preferably cache video in forward buffer 224 at a speed that is faster than real time. If the trick-play  
30 client does not receive a forward stream, the trick-play client may instead cache the real-time stream of the video in forward buffer 224.

[0047] In some embodiments, the trick-play client does not request or receive rewind and/or forward streams until after the user has viewed the video for a given time. If recording device 118 cached the real-time stream during the given time (e.g., in a real-time buffer), the trick-play client may request that the  
5 rewind stream begin when the user started viewing the video and that the forward stream begin after the given time. Then, as shown in FIG. 3, rewind buffer 322  
10 begins with frame  $F_{n-r}$  (e.g., the frame at which the user started to view the video), forward buffer 324 begins with frame  $F_{n-f}$  (e.g., the frame of the video after the given time), and real-time buffer 326 includes the video between frames  $F_{n-r}$  and  $F_{n-f}$ . Once  
15 recording device 118 begins to cache the forward stream, the trick-play client may direct recording device 118 to stop caching the real-time stream to avoid caching the same video twice. Alternatively, the  
20 trick-play client may delete the video cached in the real-time buffer and direct server 130 to provide reverse and forward streams that begin at the same frame, for example any frame between frames  $F_{n-r}$  and  $F_{n-f}$ .

[0048] When the user calls a trick-play function,  
25 the trick-play client may seamlessly migrate the video from the real-time video stream to the video cached in the rewind buffer and the real-time and/or forward buffer. The user's trick-play functionality is then provided by the buffers stored locally in the recording  
30 device, and not remotely, from the server. To play back the video cached in the rewind buffer, the trick-play client may direct recording device 118 to provide the video cached in rewind buffer 222 from frame  $F_0$  to

frame  $F_n$ . To play back the video cached in the forward buffer, the trick-play client may direct recording device 118 to provide the video cached in forward buffer 224 from frame  $F_n$  to frame  $F_y$ . The trick-play client may identify which buffers to play back using table 210 (e.g., connecting the buffers like a linked list).

[0049] The trick-play client may display a visual representation of the rewind and forward buffers using an enhanced transport control bar. FIG. 4 shows illustrative screen 400 of the video 402 that the user is viewing, and enhanced transport control bar 410. Enhanced transport control bar 410 includes title 412 of video 402, channel 414 on which the video is transmitted, as well as start time 416 and end time 418 of the video. Enhanced transport control bar 410 includes cursor 420 that indicates the current playback location and time 421 of video 402 for the user.

[0050] Enhanced transport control bar 410 includes mark 430 identifying when the user first started viewing the video. Enhanced transport control bar 410 also includes visual representations of the rewind and forward buffers into which the rewind and forward streams are cached, respectively. In particular, rewind buffer representation 432 begins at mark 430 and moves backwards in time towards the beginning of the video, and forward buffer representation 434 begins at mark 430 and moves forward in time towards the end of the video. For videos that server 130 has not recorded or cached in their entirety, and for which forward streams are not available, forward buffer representation 434 may represent the real-time buffer

that is cached with the video from the real-time stream.

[0051] FIG. 5 represents the enhanced transport control bar of FIG. 4 after the trick-play client has  
5 cached additional portions of the rewind stream and the forward stream in recording device 118 (this can be seen by comparing FIGS. 4 and 5). In enhanced transport control bar 510, cursor 520 has advanced and indicates that the current playback time is 7:36, 16  
10 minutes later than the playback time indicated in enhanced transport control bar 410 of FIG. 4. Mark 530 has not moved from FIG. 4, but rewind buffer 532 has advanced all the way to the beginning of the video, and forward buffer 534 has advanced towards the end of the  
15 video.

[0052] FIG. 6 shows another illustrative display of a visual representation of the rewind and forward buffers in an enhanced transport control bar.  
Screen 600 includes video 602 that the user is viewing,  
20 and enhanced transport control bar 610. Enhanced transport control bar 610 includes start time 612 and end time 614 of the video, cursor 620 that indicates the current playback location for the user, and representations of rewind buffer 632 and forward  
25 buffer 634. Enhanced transport control bar 610 also includes rewind cursor 622 and forward cursor 626, which are associated with rewind preview image 624 and forward preview image 628, respectively. In  
30 particular, rewind preview image 624 may correspond to the position of rewind cursor 622, and forward preview image 628 may correspond to the position of forward cursor 626. In some embodiments, the user may direct

the trick-play client to display multiple rewind and forward cursors and associated preview images.

[0053] In some embodiments, the rewind and forward cursors may correspond to the frames of the rewind and forward streams that the trick-play client is currently caching. Alternatively, the rewind and forward cursors may correspond to trick-play requests of the user (e.g., rewinding or fast-forwarding in preview images 624 or 628). The trick-play client may automatically display one or both of preview images 624 and 628, or the user may request the preview images be displayed. When the user has identified a portion of the video in preview image 624 or 628 that the user would like to play back, the user may display the preview image in full screen and play back the video at the playback position of the selected preview image.

[0054] The buffers for caching the video may be arbitrarily limited in size, or limited only by the space available on recording device 118. If the buffers are limited in size or recording device 118 has limited space available, the buffer may not be large enough to cache an entire video. To provide enhanced trick-play functions to the user, the trick-play client may cache the rewind and/or forward streams in buffers, and overwrite the rewind and/or forward buffers as necessary to comply with a user trick-play request (e.g., in response to a rewind request that extends to video not cached in the rewind buffer, request a new rewind stream that is cached in place of the forward buffer). The trick-play client may, instead or in addition, identify advertisements in the rewind and forward streams (e.g., from packet identifiers) and not cache the advertisements.



[0055] Once the entire video is cached in buffers, the client may, automatically or in response to a user instruction, save the cached video as a recording for future viewing. In some embodiments, the client may, automatically or in response to a user instruction, save an incomplete video that is cached in the buffers.

[0056] In some embodiments, server 130 may not cache or record every video that is provided to user equipment 110. The trick-play client may then, before requesting a rewind and/or forward stream, determine whether server 130 has cached or recorded the video. For example, the trick-play client may receive an indication from server 130 whether the video is available. In response to determining that the video is in fact available, the trick-play client may request the rewind and/or forward streams from server 130.

[0057] The trick-play client may determine whether server 130 has cached or recorded a partially or in its entirety video at any suitable time. For example, server 130 may identify for the trick-play client the videos that the server has or will cache or record for a given time period (e.g., the next day or week) at regular intervals. Server 130 may further specify to the trick-play client the time at which the videos will be cached or recorded in their entirety. The trick-play client may in turn identify the videos for the user. For example, the trick-play client may display an icon, shade the listing, change a color, or provide any other suitable indication on the transport control bar or in a program grid.

[0058] FIG. 7 shows illustrative program grid screen 700 that includes grid 702 of program listings. The programs listed in grid 702 that have been cached

or recorded by server 130 are identified by icons 710 and 712. Rewind icon 710 indicates that server 130 has at least partially cached or recorded the program associated with the icon, and that a rewind stream is  
5 available (e.g., "Friends" and "The Sopranos").

Forward icon 712 indicates that server 130 has cached or recorded the program associated with the icon in its entirety, and that a forward stream is available (e.g., "The Bourne Identity"). The trick-play client may  
10 display both rewind icon 710 and forward icon 712 to indicate that both rewind and forward streams are available. Alternatively, the trick-play client may display only forward icon 712 to indicate that rewind and forward streams are available (e.g., because if an  
15 entire video is cached or recorded, the server may provide a rewind stream). Though FIG. 7 shows icons, the program grid may include any other suitable indication. The trick-play client may use one or more indicators to identify videos for which a user may  
20 request rewind or fast-forward streams.

[0059] The following flow charts serve to illustrate processes involved in some embodiments of this invention. FIG. 8 is a flow chart of an illustrative process for rewinding a video to a point prior to when  
25 the user first started viewing the video. Process 800 begins at step 802. At step 810, the user selects a non-on-demand video after the video has already started (e.g., starts viewing a broadcast program after the broadcast has started). For example, the user may  
30 direct a tuner in control circuitry 116 to tune to a real-time stream provided by media source 120 by entering a channel number or by selecting a program

from a suitable trick-play client display (e.g., a program guide grid).

[0060] At step 820, the trick-play client determines whether the user has a sufficient interest in the video to warrant requesting a rewind stream. For example, the trick-play client may determine whether the user has viewed the video for a given amount of time, or whether the user has called a trick-play function (e.g., "rewind"). In some embodiments, prior to step 820, the trick-play client may determine whether server 130 has cached or recorded the selected video. In the process shown in FIG. 8, however, this step has been omitted. If the trick-play client determines that the user does not have a sufficient interest in the video to warrant requesting a rewind stream, process 800 moves to step 852 and ends.

[0061] If instead, at step 820, the trick-play client determines that the user has a sufficient interest in the video to warrant requesting a rewind stream, process 800 moves to step 830. At step 830, the trick-play client requests a rewind stream from server 130. The rewind stream includes the video that was transmitted by media source 120 prior to the time when the user first selected the video. The video of the rewind stream may begin at the time when the user first selected the video, and stream backwards in time to the beginning of the video. The rewind stream may provide the video content in any suitable manner such as, for example, reverse-order bitwise.

[0062] At step 840, the trick-play client receives the rewind stream from server 130 over communications path 122 and directs recording device 118 to cache the rewind stream in one or more rewind buffers. At

step 850, the trick-play client rewinds the video to a point prior to when the user first selected the video by rewinding the video through the one or more rewind buffers. The trick-play client may then play back the video from the one or more rewind buffers. Process 800 ends at step 852.

[0063] FIG. 9 is a flow chart of an illustrative process for fast-forwarding a video to a point that has not yet been reached by the real-time stream of the video. Process 900 begins at step 902. At step 910, the user selects a non-on-demand video transmitted in a real-time stream (e.g., a broadcast program). For example, the user may direct a tuner in control circuitry 116 to tune to a real-time stream provided by media source 120 by entering a channel number or selecting a program from a suitable trick-play client display (e.g., a program guide grid).

[0064] At step 920, the trick-play client determines whether server 130 has recorded or cached the entire video. For example, the trick-play client may request an indication from server 130 of the videos that have been recorded or cached in their entirety. As another example, the trick-play client may determine that server 130 recorded or cached a video if the video is a re-run or a repeated program (e.g., a repeat episode of a popular series). If the trick-play client determines that server 130 has not recorded or cached the video, process 900 moves to step 962 and ends.

[0065] If instead, at step 920, the trick-play client determines that server 130 has recorded or cached the video, process 900 moves to step 930. At step 930, the trick-play client determines whether the user has a sufficient interest in the video to warrant

requesting a forward stream. For example, the trick-play client may determine whether the user has viewed the video for a given amount of time, or whether the user has called a trick-play function (e.g., "fast-forward"). If the trick-play client determines that the user does not have a sufficient interest in the video to warrant requesting a forward stream, process 900 moves to step 962 and ends.

[0066] If instead, at step 930, the trick-play client determines that the user has a sufficient interest in the video to warrant requesting a forward stream, process 900 moves to step 940. At step 940, the trick-play client requests a forward stream from server 130. The forward stream includes the entire video (e.g., without skipping any video frames) that was transmitted by media source 120 at least after the time when the user first selected the video (e.g., after the time at which the user requested the forward stream). In some embodiments, server 130 provides the forward stream to user equipment 110 at a speed that is greater than the speed of the real-time stream (e.g., at a speed greater than 1x).

[0067] At step 950, the trick-play client receives the forward stream from server 130 over communications path 122 and directs recording device 118 to cache the forward stream in one or more forward buffers. At step 960, the trick-play client fast-forwards the video through the forward buffer. The trick-play client may then play back the video from the one or more cached forward buffers. Process 900 ends at step 962.

[0068] FIG. 10 is an illustrative flow chart for transmitting rewind and forward streams to user equipment 110. Process 1000 begins at step 1002. At

step 1010, server 130 receives videos from media source 120, for example in a real-time stream that is also provided to the instances of user equipment 110 of interactive media system 100. At step 1020, server 130  
5 determines whether to record or cache some or all of the videos received at step 1010. Server 130 may determine whether to record or cache a particular video using any suitable criteria (e.g., popular videos or preferred video providers). In some embodiments, media  
10 source 120, user equipment 110 or another device of interactive media system 100 may specify for server 130 which videos to cache or record.

[0069] If, at step 1020, the server determines that no videos are to be recorded or cached, process 1000  
15 moves to step 1062 and ends. If instead, at step 1020, the server determines that at least one particular video is to be recorded or cached, process 1000 caches the at least one particular video and moves to step 1030. In some embodiments, process 1000 may skip  
20 step 1020 and simply record or cache every video.

[0070] At step 1030, server 130 receives a request from the trick-play client implemented on user equipment 110 for a video. The trick-play client may request a rewind stream of video that was transmitted  
25 before the user of the trick-play client started viewing the video. The trick-play client may also or instead request a forward stream of video that has not yet been transmitted by the real-time stream provided by the media source.

30 [0071] At step 1040, server 130 determines whether server 130 has recorded or cached the video required for the requested streams. For example, when a user requests a forward stream, the server may determine

whether it has already recorded or cached the requested video in its entirety. If server 130 determines that it has not recorded or cached the video required for all of the requested streams, process 1000 moves to  
5 step 1062 and ends.

[0072] If instead, at step 1040, server 130 determines that it has recorded or cached at least some of the video required for the requested streams, process 1000 moves to step 1050. For example,  
10 server 130 may determine that it has cached the video needed for a rewind stream, but not the video required for a forward stream. At step 1050, server 130 generates at least one requested stream (e.g., a forward stream or a rewind stream) with the video  
15 required for the stream. At step 1060, server 130 transmits the at least one requested stream generated at step 1050 over communications path 122 to the trick-play client implemented on user equipment 110. Process 1000 ends at step 1062.

20 [0073] FIG. 11 is an illustrative flow chart for playing back a video that has been cached in a rewind buffer and in a forward buffer with user equipment 110. Process 1100 begins at step 1102. At step 1110, the trick-play client receives a user request to play back  
25 at least a portion of a video cached in a rewind buffer and a forward buffer from the buffers. For example, the trick-play client may receive a user request to play back a video from the beginning.

[0074] At step 1120, the trick-play client  
30 identifies the video frame from which the user would like to start playing back the video. For example, if the user, while rewinding the video from the rewind buffer, selects a "play" key, the trick-play client may

2013203314 10 Apr 2013

identify the video frame displayed at the time the user selected the "play" key.

[0075] At step 1130, the trick-play client determines whether the video frame identified at  
5 step 1120 is in the rewind buffer. If the trick-play client determines that the video frame is in the rewind buffer, process 1100 moves to step 1140. At step 1140, the trick-play client displays the identified frame on display device 112, and subsequently moves towards the  
10 beginning of the rewind buffer and displays the next frames cached in the rewind buffer. For example, if the rewind buffer begins at frame  $F_n$ , ends at frame  $F_0$  (i.e., the beginning of the program), and the trick-play client identified frame  $F_i$ , the trick-play client  
15 displays frame  $F_i$ , then frame  $F_{i+1}$ , frame  $F_{i+2}$ , all the way to frame  $F_n$ . In other words, the trick-play client moves through the buffer with a first-in, last-out scheme.

[0076] At step 1150, the trick play client displays  
20 the last frame of the rewind buffer and migrates to the forward buffer. In some embodiments, the trick-play client may instead migrate to a real-time buffer (e.g., if there is no forward buffer, or if there is a real-time buffer between the rewind buffer and the forward  
25 buffer).

[0077] At step 1160, the trick play client displays the first frame of the forward buffer on display device 112, and subsequently moves towards the end of the forward buffer and displays the next frames cached  
30 in the forward buffer. For example, if the forward buffer begins at frame  $F_n$ , ends at frame  $F_y$  (i.e., the end of the program), the trick-play client displays frame  $F_n$ , then frame  $F_{n+1}$ , frame  $F_{n+2}$ , all the way to



frame  $F_y$ . In other words, the trick-play client moves through the buffer with a first-in, first-out scheme.

5 [0078] Process 1100 may also access step 1160 if, at step 1130, the trick-play client determines that the video frame is not in the rewind buffer (e.g., the identified frame is in the forward buffer). In that case, instead of the trick-play client first displaying the first frame of the forward buffer, the trick-play client first displays the frame identified at step 1120. Process 1100 then ends at step 1162.

10 [0079] The above described embodiments of the present invention are presented for purposes of illustration and not of limitation, and the present invention is limited only by the claims which follow.

15 [0080] Throughout this specification, including the claims, where the context permits, the term "comprise" and variants thereof such as "comprises" or "comprising" are to be interpreted as including the stated integer or integers without necessarily excluding any other integers.

2013203314 10 Apr 2013

**The claims defining the invention are as follows:**

1. A method comprising:  
displaying a plurality of program listings;  
identifying a program listing for which a rewind stream or a forward stream is available by an indicator; and  
displaying the program listing with the indicator.
2. The method of claim 1 wherein the indicator is an icon, shading, or coloring.
3. The method of claim 1 further comprising displaying the plurality of program listings in a grid.
4. The method of claim 1 further comprising:  
receiving from a server, time information for a program listing for which a rewind stream is available; and  
receiving from the server, time information for a program listing for which a forward stream is available.
5. The method of claim 1, further comprising:  
determining whether a server has stored a program associated with the program listing.
6. The method of claim 1, wherein the indicator indicates that a forward stream is available.
7. The method of claim 1, wherein the indicator indicates that a rewind stream is available.
8. The method of claim 1, further comprising:  
determining that a user has a sufficient interest in a non-on-demand video program associated with a program listing;

2013203314 10 Apr 2013

sending a request for a rewind stream, in response to determining that the user has a sufficient interest in the non-on-demand video program; and

receiving the rewind stream, in response to sending the request for the rewind stream.

9. The method of claim 1, further comprising:

determining that a user has a sufficient interest in a non-on-demand video program associated with a program listing;

sending a request for a forward stream, in response to determining that the user has a sufficient interest in the non-on-demand video program; and

receiving the forward stream, in response to sending the request for the forward stream.

10. The method of claim 8 further comprising:

accessing the non-on-demand video after the start of the transmission of the video, wherein the non-on-demand video is associated with the program listing displayed with an indicator;

receiving the rewind stream comprising a first frame corresponding to a time when the video was accessed and a last frame corresponding to the start of the video, wherein the rewind stream when, played back, displays the video content in substantially continuous reverse order without skipping any video frames from the first frame of the rewind stream toward the last frame of the rewind stream;

caching the rewind stream in a rewind buffer;

rewinding the video through the rewind buffer; and

playing back the video from the rewind buffer.

11. A system comprising:

means for displaying a plurality of program listings;

2013203314 10 Apr 2013

means for identifying a programming listing for which a rewind stream or a forward stream is available by an indicator; and

means for displaying the program listing with the indicator.

12. The system of claim 11 wherein the indicator is an icon, shading, or coloring.

13. The system of claim 11 further comprising means for displaying the plurality of program listings in a grid.

14. The system of claim 11 further comprising:

means for receiving from a server, time information for a program listing in the grid for which a rewind stream is available; and

means for receiving from the server, time information for a program listing in the grid for which a forward stream is available.

15. The system of claim 11, further comprising:

means for determining whether a server has stored a program associated with the program listing.

16. The system of claim 11, wherein the indicator indicates that a forward stream is available.

17. The system of claim 11, wherein the indicator indicates that a rewind stream is available.

18. The system of claim 11, further comprising:

means for determining that a user has a sufficient interest in a non-on-demand video program associated with a program listing;

2013203314 10 Apr 2013

means for sending a request for a rewind stream, in response to determining that the user has a sufficient interest in the non-on-demand video program; and

means for receiving the rewind stream, in response to sending the request for the rewind stream.

19. The system of claim 11, further comprising:

means for determining that a user has a sufficient interest in a non-on-demand video program associated with a program listing;

means for sending a request for a forward stream, in response to determining that the user has a sufficient interest in the non-on-demand video program; and

means for receiving the forward stream, in response to sending the request for the forward stream.

20. The system of claim 11, further comprising:

means for accessing the non-on-demand video after the start of the transmission of the video, wherein the non-on-demand video is associated with the program listing displayed with an indicator;

means for receiving the rewind stream comprising a first frame corresponding to a time when the video was accessed and a last frame corresponding to the start of the video, wherein the rewind stream when, played back, displays the video content in substantially continuous reverse order without skipping any video frames from the first frame of the rewind stream toward the last frame of the rewind stream;

means for caching the rewind stream in a rewind buffer;

means for rewinding the video through the rewind buffer;

and

means for playing back the video from the rewind buffer.

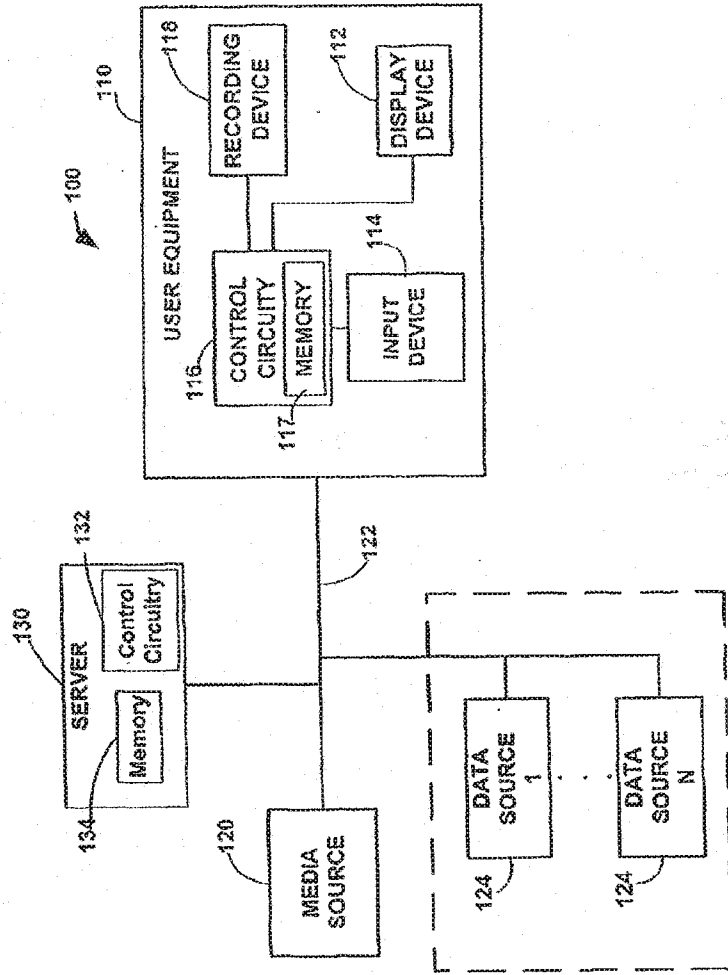


FIG. 1

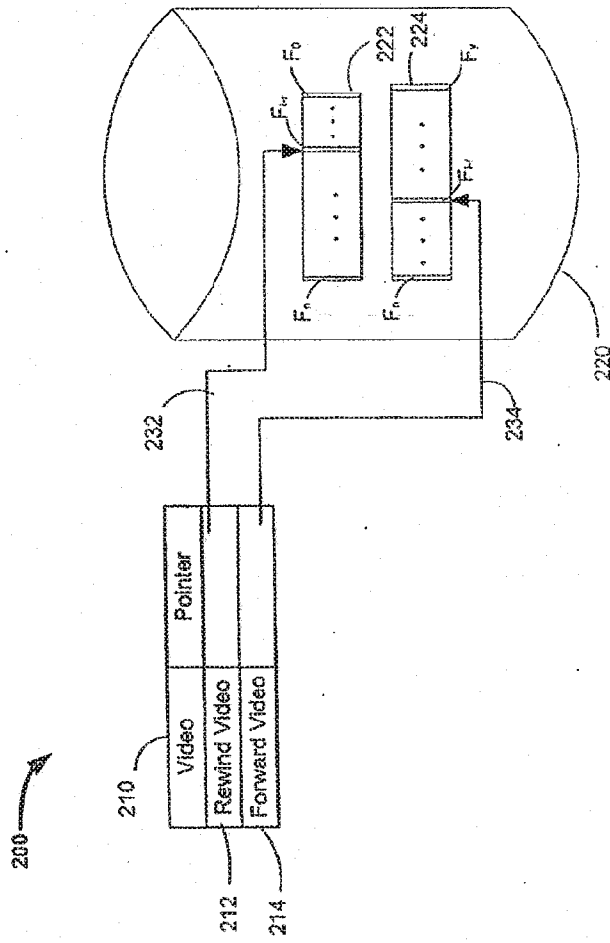


FIG. 2

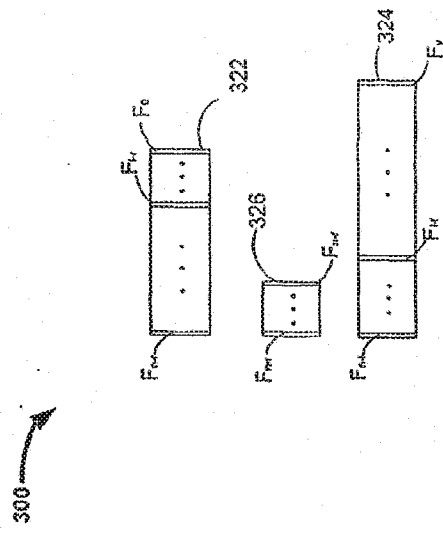


FIG. 3





FIG. 4

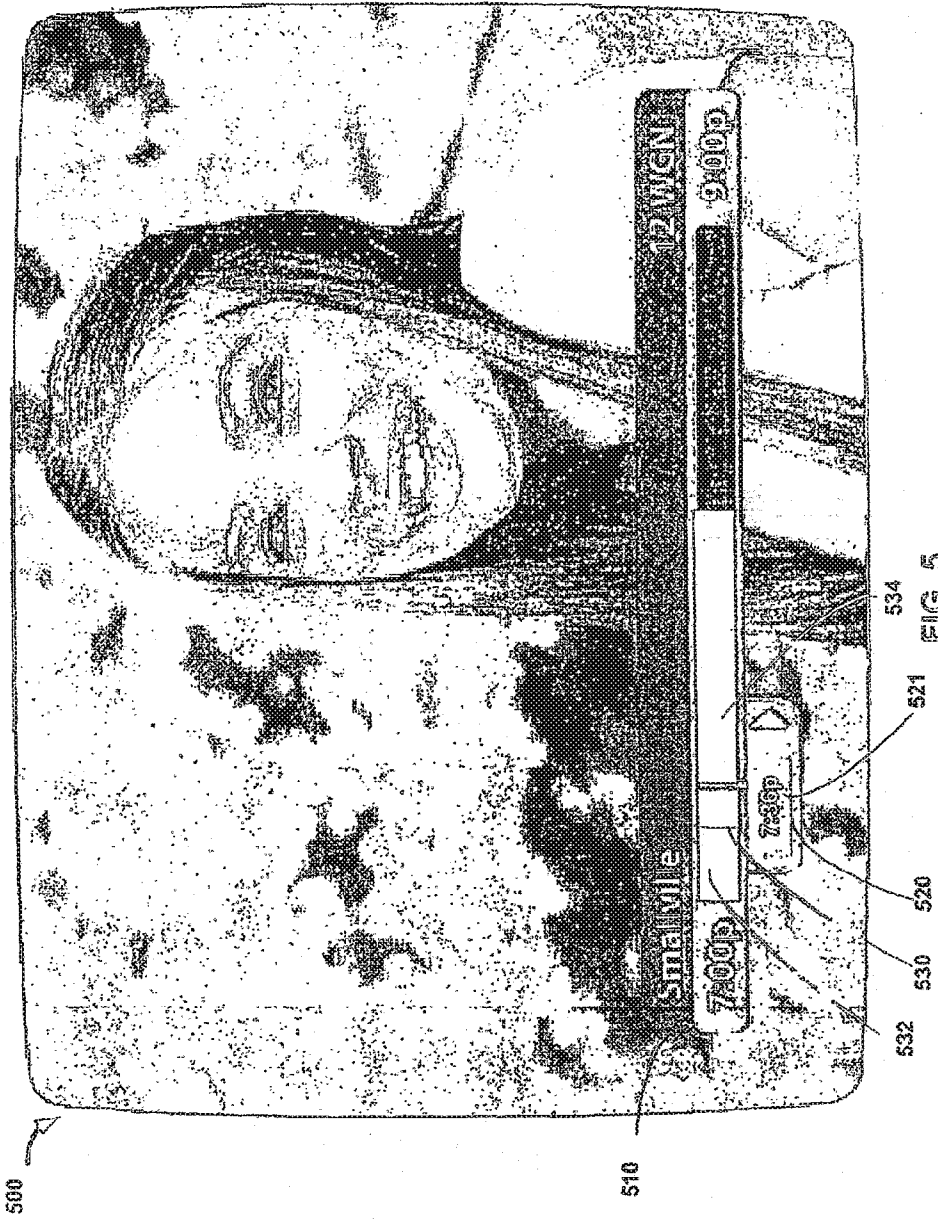


FIG. 5

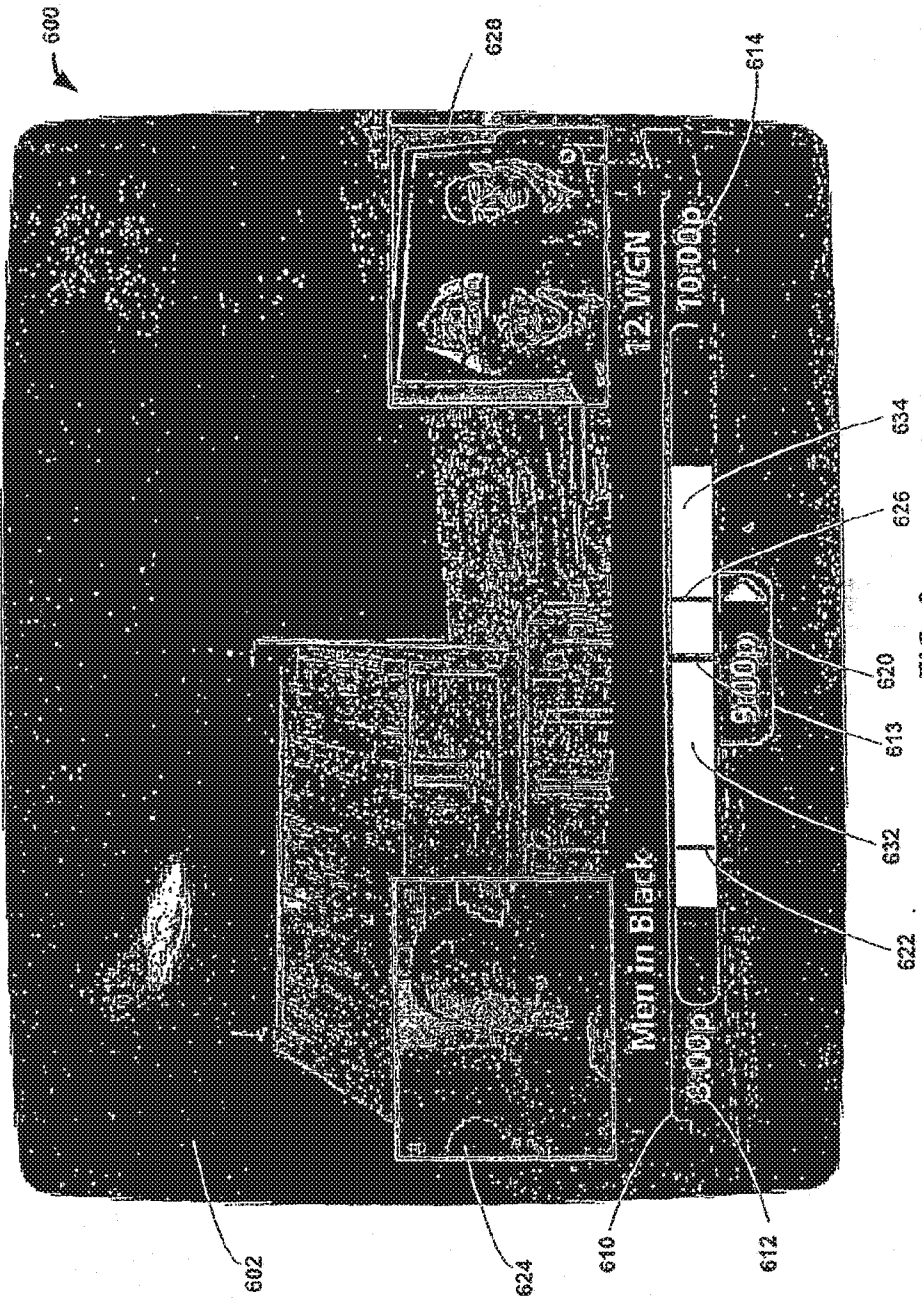


FIG. 6

Time	7:00pm	7:30pm	8:00pm
7:00pm	The Simpsons	King of the...	Joe Millionaire
7:30pm	The Bourne Identity	Friends	ER
8:00pm	The Sopranos	Real World Xl Music Videos	Music Videos

700

702

FIG. 7

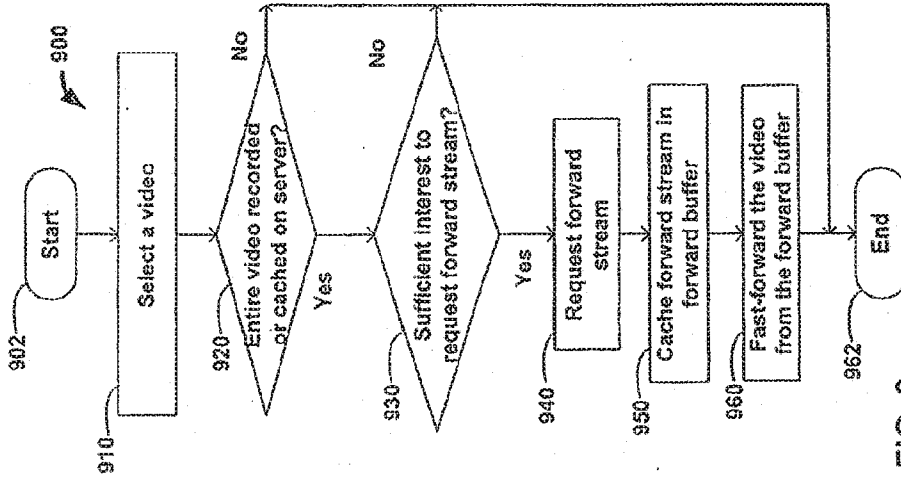


FIG. 9

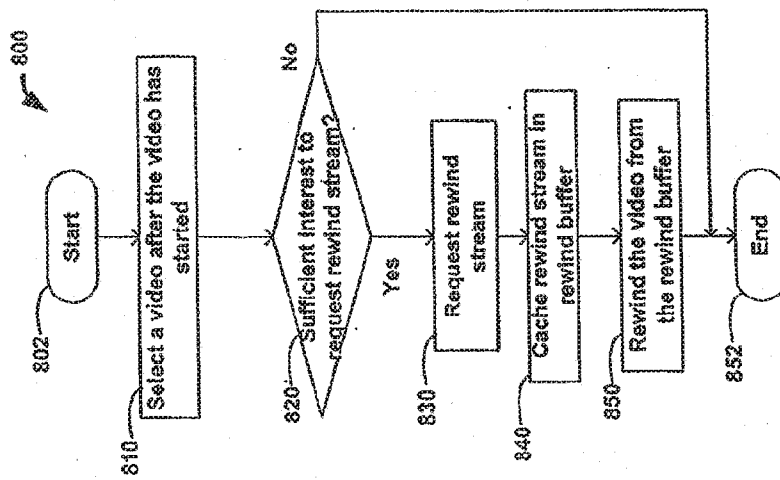


FIG. 8

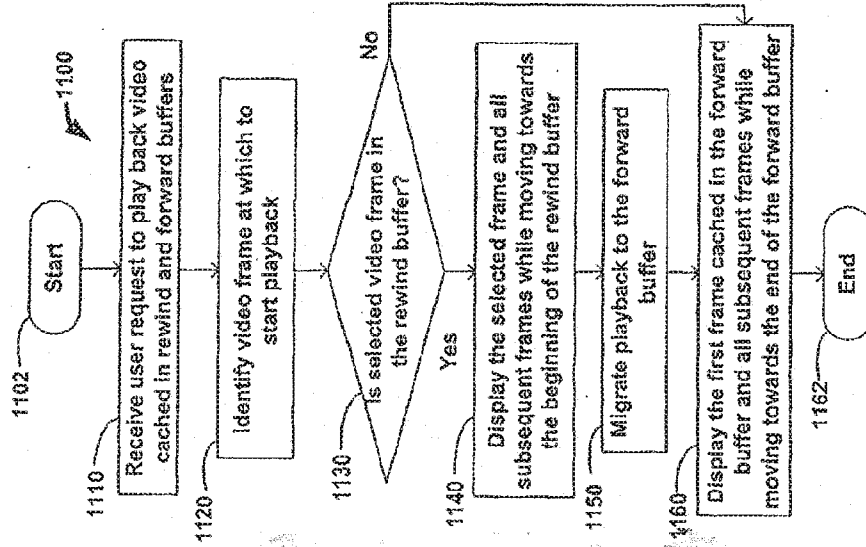


FIG. 10

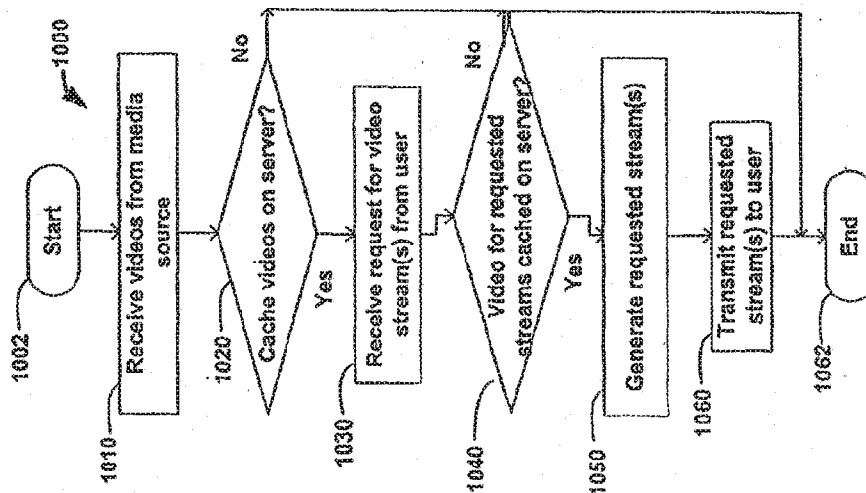


FIG. 11