HDD-記録型 DVD ハイブリッドビデオレコーダの開発

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あらまし
HDD と記録型 DVD を組合せたハイブリッドビデオレコーダを開発した。重要な要素技術として、同時記録再生動作に関連したユーザインターフェース、自动生成録画に適したファイルシステム、広帯域データバッファコントローラを開発した。

キーワード ビデオディスク、録画機、HDD、DVD

Development of Combined HDD and Recordable-DVD Video Recorder

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Abstract
Hybrid type video disk recorder, in which HDD and Recordable-DVD drives are combined, was developed. The developed key technologies are such as user interface suitable for simultaneous recording and playback, file system suitable for automatic updating recording, and wide bandwidth data buffer controller.

Keyword Video Disk, Recorder, HDD, DVD

NII-Electronic Library Service
1. Introduction

Hybrid type video disk recorder, in which Hard disk and recordable-DVD drives are combined, was developed. Disk recording media has a remarkable ability to improve user's convenience during video disk operation, such as simultaneous recording and playing back, by using random accessibility, which is explicitly differs from conventional tape recording media.

To best utilize the above features, several key technologies become important, as listed bellow, and were developed:

1. User operation environment suitable for simultaneous recording and playing back.
2. Disk file system suitable for automatic updating recording.
3. Wide bandwidth data transfer path for simultaneous write and read operations.

2. System Configuration

Simplified block diagram of the developed recorder is shown in figure 1. Video stream is encoded by the MPEG Encoder and recorded on the disk through the Buffer controller. The recorded stream is again read out from the disk to the MPEG Decoder through the Buffer controller and the MPEG decoded stream is merged with the input video stream at the Graphics processor so that two pictures are displayed on the monitor.

Figure 1. Block diagram of hybrid type video disk recorder

To implement the above mentioned key technologies into the recorder, following methods were studied;

1. To display two picture windows, one of which is for monitoring the contents under recording and the other is for playing back another selected part of any contents on the disk and either of these two is activated, high performance graphics processor was employed. User's key operation is permitted only for the activated window and, as a result, unintentional mis-operations by users become avoided.

2. To realize long-term time-shift playback during recording, playing back of plural grouped programs, and other beneficial functions, file allocation method and management method was devised. Certain size of the disk area is reserved for time-shift function and other certain area is dedicated for the plural grouped programs.

3) To enable simultaneous real-time data write and read operations on the drives through a data bus continuously, sophisticated buffer management method is introduced into the buffer controller. The buffer area is divided into several banks and each is assigned to a data path between the disk drives and the MPEG Encoder or Decoder. The controller watches amounts of data in each buffer bank and switches them not to overflow or underflow.

3. Results

Several important results for the key technology is summarized as follows.

3.1 Picture window and key operation

Figure 2 shows an example of imposed picture windows. When a user is going to record a picture to the recordable DVD disk while playing back other recorded program from the HDD, sub-window for a picture to be recorded shall be activated, and it can be monitored for confirmation.

Figure 2. Example of imposed picture windows

Relationship between a status of the recorder and user's key operation is shown in Table 1. STOP or REC key is effective only for activated window.

Table 1. Operation in each mode at user's key operation

<table>
<thead>
<tr>
<th>No</th>
<th>Status of Recorder</th>
<th>User's Key Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mode</td>
<td>Sub-window</td>
</tr>
<tr>
<td>1</td>
<td>Playback</td>
<td>Not activated</td>
</tr>
<tr>
<td>2</td>
<td>Playback</td>
<td>Activated</td>
</tr>
<tr>
<td>3</td>
<td>Simultaneous Recording and Playback</td>
<td>Not activated</td>
</tr>
<tr>
<td>4</td>
<td>Simultaneous Recording and Playback</td>
<td>Activated</td>
</tr>
</tbody>
</table>
3.2 File management

Figure 3 shows a divisional structure of recording areas on HDD. Recording files for each content were classified into one of three types listed in the figure and recorded in the dedicated area.

- Recording area for time-shift operation (playback during/after recording)
- Recording area for grouped programs
- Recording area for ordinary recording

Figure 3. Divisional structure of recording area on HDD

By pre-assigning these areas while initialization, necessary capacity of the recording area for each type of recording was secured.

3.3 Data bus traffic

Figure 4 shows a measurement result of the data bus traffic. In this measurement, audio and video data is being recorded onto the recordable DVD at the highest data rate of 10.08Mbps, while the HDD is playing back a recorded contents also at the highest data rate of 10.08Mbps. Data transfer block size is 256Kbytes for both drives. The horizontal axis is time elapsed and the vertical axis is execution time of one transfer operation to/from the drives. The execution time is about 37 msec for DVD and 17 msec for HDD. Data bus occupancy was measured as 34%, and no overflow nor underflow was observed.

This result shows that the data bus is managed by the Bus controller so as to have sufficient margin for the traffic, even in case of the maximum data transfer while simultaneous recording and playback operation of the DVD and the HDD.

4. Conclusion

Combining these technologies in the hardware and firmware, the developed hybrid type video disk recorder has achieved well-balanced user convenient features as a consumer appliance.

Acknowledgment

Authors express great appreciation to Mr. Isao Otsuka, Mr. Tomoaki Ryu, Mr. Tomohide Okumura and Mr. Yoshinori Watanabe for their cooperation in studying and prototyping the system described in this paper.