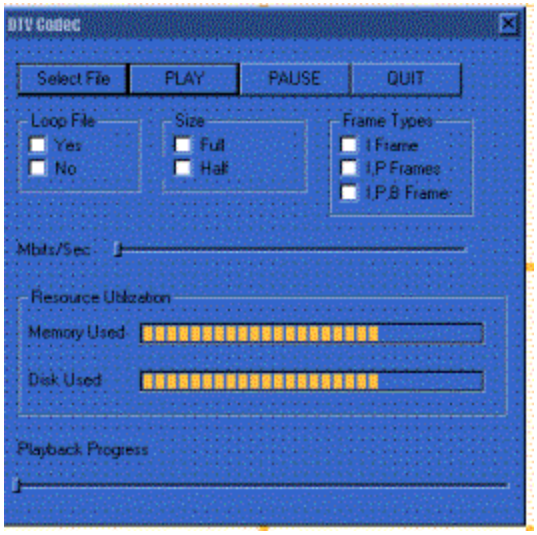
Digital VCR



People

- Edward Chang

Proposal

Objectives

- Decouple the traditionally isochronous nature of TV by buffering the incoming DTV stream on the client
- Minimize RAM usage by intelligent buffer and disk-IO management
- Base technology for many projects

Overview

- Display can be *paused*: incoming video is buffered on disk
- Display can be *resumed*: displayed video comes from disk -- incoming video is going to disk (FIFO)
- Display can *fast forward*: scan or skip through buffered video until catched up with live reception

Description

As part of the support infrastructure we have implemented a video buffer that supports VCR-like operations such as slow motion, pause, replay, and fast forward. The buffer could be used in applications such as personal sports replays, self-paced lectures (see Section), flexible guided tours (see Section), or for downloading a movie during the night that you want to watch tomorrow.

To implement the VCR-like interactive features, a cache manager is required that is able to buffer a large amount of data and supply it to the decoder in real-time. Since the memory requirement can be huge, a main-memory-only buffering approach may be prohibitively costly. The alternative is using a memory-disk integrated cache (MEDIC) . Since the per-byte disk cost is about one hundredth of the per-byte memory cost, MEDIC is economically attractive.

MEDIC carefully allocates a limited amount of memory to competing tasks, i.e. to receiving new data from network channels, to writing data to disk as memory fills up, to reading data from disk as needed, and to holding data for decoding and playback. Since data is concurrently written to the disk cache and read from the disk cache, MEDIC must intelligently issue IOs to maximize throughput and to avoid undue conflicts.

With less than 8 MB of RAM our video buffer can support the interactive operations discussed above without causing any ``jitter''. This result confirms the theoretical study . The Figure above shows an application of video buffering for implementing a Virtual VCR.

Related Publications

Ex. 2002
Dish Network L.L.C. and Dish Technologies L.L.C. v. Digital Broadcasting Solutions, LLC, IPR2023-00976

- [1] MEDIC: A Memory & Disk Cache for Multimedia Clients.

  Edward Chang and Hector Garcia-Molina
  Technical Report SIDL-WP-1997-0076, November 1997.
- [2] BubbleUp: Low Latency Fast-Scan for Media Servers.

  Edward Chang and Hector Garcia-Molina
  [ACM Copyright] Proceedings of the 5th ACM International Conference on Multimedia, p.87-98, Seattle, November 1997.
- [3] Effective Memory Use in a Media Server.

  Edward Chang and Hector Garcia-Molina
  [VLDB Copyright] Proceedings of the 23rd Very Large Data Base (VLDB) Conference, p.496-505, Athens, Greece, August 1997.

Last Updated: Feb. 25, 1999, slusallek@graphics.stanford.edu