Efficient Real-time Similarity Detection for Video Caching and Streaming

byte mobile

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Video Similarity Detection System

- Enterprise-level video cache system between Internet users and content providers
- Generalize a "cache hit"
  - Byte-wise identical
  - Similar, human perception-wise
- Upon cache hit, deliver an identical or similar version, compared to requested video
- Real-time detection
  - Small video signatures
  - Extract information from incoming video byte stream

- Motivations and benefits
  - Internet videos: Many duplicates and similars, due to diversity of processing situations
  - Codec/format agnostic
  - Reduce cache storage requirements
  - Reduce cache processing load
  - Enrich user experience and analytics

Similarity Metric

- Associate feature vectors with each video
- Each feature vector based on a subset of *time-averaged DCT coefficients of I-frames within a time epoch, extracted directly and efficiently from the video byte stream*
- Similarity metric between 2 videos is the sum of the L2 norms between their respective feature vectors

Similarity Detection

- Cumulative error between 2 videos is their similarity metric up to a certain time in the videos
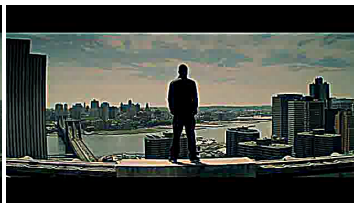- Used thresholding to determine similarity

Experiments

- Take 20 YouTube videos, which are obviously dissimilar
- For each video, generate similar versions, using simple video processing (e.g. filtering) techniques
- We have ground truth of similarity
- Use metric to count similars
- Calculate empirical CDFs of cumulative errors of pair-wise similar and dissimilar videos
- Calculate false negative rates and false positive rates
- Results indicate that thresholding can be used to push both false negative rates and false positive rates to zero, simultaneously
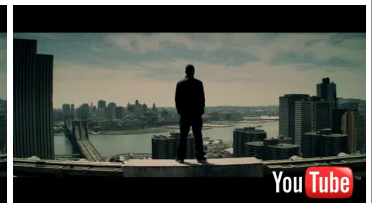
Similar Videos
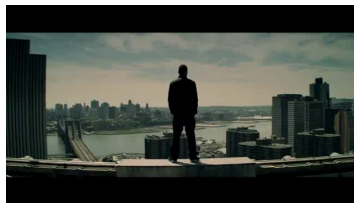
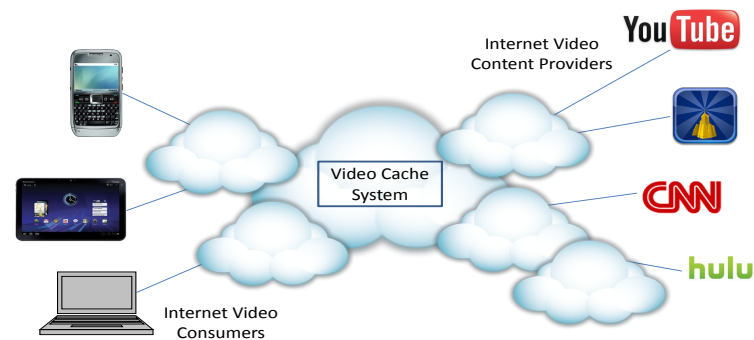
| Original Video | Sharpened Video | Blurred Video | Logo in Top Left | Logo in Bottom Right |

System Diagram

Internet Video Content Providers

Video Cache System

Internet Video Consumers

Results

CDFs: Different Resolutions

CDFs: Watermarking

CDFs: Everything

Rates: Different Resolutions

Rates: Watermarking

Rates: Everything