REPLAY – An integrated lecture recording infrastructure to interactively and collectively generate learning objects

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1. EXECUTIVE SUMMARY

1.1. Status quo in lecture recording

With the advent of the podcast era, lecture recording is about to reach critical mass status: Using affordable equipment and infrastructure, academic institutions (e-learning centres, multimedia services etc.) as well as individuals (teachers, researchers, students) produce audiovisual objects in exploding numbers. Their actual value, however, remains limited both short- and long-term.

1.2. Shortcomings

iTunes U and *Berkeley on YouTub*e are the visible tip of an iceberg consisting of thousands of single audiovisual objects – with considerable intellectual value, individually, but even more so collectively. However, given the diversity in formats, standards, operating systems etc. as well as the problem of searchability, publications remain limited in their coverage. In addition, the long-term perspective of these objects produced with considerable effort is anything but safeguarded as issues of handling, archival, standardization etc. are rarely addressed.

1.3. REPLAY

REPLAY is an open solution to preserve this intellectual value by providing an integrated system to record, process, index, and distribute recorded lectures; additional archival, persistent handling and preservation of these objects are the core of a developing teaching/learning knowledge pool.

At the user's end, REPLAY replaces mere consumption of videos with an interactive and collective usage, enriching objects with comments, added material, cross-references etc.

In conjunction, ephemeral recordings are being transformed into long-lasting learning objects.

2. KEY FEATURES OF REPLAY

ETH Zurich's REPLAY is an integrated solution to the field of lecture recording in that it provides solutions from the production site to the distributive and consumptive end. The system layout is modular so that specific parts of the implementation can either be customized according to individual needs or completely be replaced by third-party components providing equal or better functionality; adding components is also feasible (authentication etc.). This also implies scalability: Designed as a distributed solution with large scale deployment in mind , it will also allow for one-server-solutions to cover smaller implementations; ETH Zurich itself is set to produce 150 lectures a week in 2010.

2.1. Classroom production - PLAYMOBIL

The workflow originates in the classroom, where the Linux-based PLAYMOBIL

- receives and levels an audio signal from the lecturer,

- captures an automatically tracked video signal of the lecturer,

- and grabs a VGA-signal from the lecturer's computer (platform-agnostic).

This implies a "non-contact" recording in that the lecturer only has to connect to the projector and use a microphone - just as he or she would without recording. PLAYMOBIL then bundles the named sources and passes them into the REPLAY workflow. As for the overall infrastructure of PLAYMOBIL, recording jobs are being accepted, handled, and managed with an automated scheduler to start and end recordings - lecturers are not expected to become part of the production here.

2.2. Indexation

The content-video (i.e. the captured slides) is indexed using Optical Character Recognition (OCR) on the slides. Emphasis can be given to the quantitative (number of occurrences per slide etc.) and qualitative (font size) attributes of content for weighting and later ranking. The resulting isochronic metadata is stored using the MPEG-7 standard thus providing a solution to use videos "on the spot" - access is actually content-based and does not depend on manually attributed metadata anymore; it also is precise in that it opens the formerly monolithic video for users to come to the point (of interest) faster: Searching for slides featuring "exam" becomes possible.

2.3. Archival, persistent identification

The bundle is then archived based on the original formats (DV, H.264) to safeguard long-term access and a high quality source for future re-indexing and re–encoding. The latter is not only essential to cover future distributive formats in the best possible quality. It also provides for the archive's claim to outlast 30 to 50 years as this includes transcoding the archived objects.

To complete this perspective, bundles are referenced upon using Digital Object Identifiers (DOI): To safeguard access in the longer run, URL are not adequate since the content may be moved to another domain, thus invalidating URL-based references. Based on the CNRI Handle System and drawing on the services of a registration agency, an abstraction layer is established between the physical location of the object and the reference given to the user, resulting in a long-term accessibility of the resource.

2.4. Transcoding, distributive formats

The transition from archive to distributive end takes place in the transcoding instance: Here, a variety of formats is produced and kept in a distribution cache. One distributive format is persistent in that it will be procured permanently for instant consumption; others will be eliminated from the cache after a set period of non-consumption (Least Recently Used, LRU), but can be transcoded on-demand with users being informed automatically about provision.

Chosen formats should cover all relevant platforms, bandwidths and consumption types, ranging from open audio formats such as OGG to the omnipresent Flash, which is also the format of choice for the user interface.

2.5. User interface: Activating the consumer

The user interface on the one hand is set to provide new presentation modes for video search results by averting mere listings: It will take advantage of isochronic metadata and timeline-based access to video material, thus providing a content-based pin point access to video.

It also represents the change from a mere consumption to an interactive usage in that it provides features to comment, discuss, evaluate, enrich and re-edit lectures: Lecturers, students, and peers can comment upon the video, add material (e.g. relevant literature) or related videos. All of this takes place time-related in that these activities will be performed on the timeline: Discussions can unfold upon a marked-off passage of the lecture and additional material can be placed right where it's needed: The PDF with the examination regulations comes right at the point where "exam" is on the slide.

2.6. E-Learning: Interactive and collaborative enrichment

Today, lecture recordings are nothing but TV-style reruns of lectures, themselves not known for their interactive potential. By providing the tools to work with the object in the ways described, REPLAY will open audiovisual material for interactive and collective enrichment, thus transforming them from recordings to enhanced learning objects.

This in turn will lead to an e-learning experience adjusted to state-of-the-art didactics: Students can work upon the lecture collectively, discuss given issues with their peers with guidance from the lecturer, access to the objects can be adjusted to their learning patterns, their standard of knowledge and their usage patterns, thus providing a customized learning experience.

2.7. Miscellaneous

REPLAY is a solution not only to current productions but will also take care of legacy formats as universities typically have to handle the ingest of older media (VHS, DVD, DV etc.) or proprietary and/or outdated formats.

REPLAY will be able to connect to relevant academic systems (LMS, university calendars), archives (Open Archives Initiative) and libraries (compliant with Dublin Core).

3. ABOUT THE REPLAY PROJECT

IT Services at ETH Zurich have developed REPLAY as a strategic answer to current and future needs in the domain of lecture recording and distribution. REPLAY 0.3 has been released in April 2008 after two years of requirements analysis, system design, implementation with REPLAY 1.0 set to become operative at ETH by the end of 2008. REPLAY is an open development with ETH inviting other universities to join a community of users; it is open source under the Lesser GNU General Public License (LGPL).

4. FUTURE DEVELOPMENTS

REPLAY will benefit from developments specifically in the areas of

- speech recognition by adding audio as a source for indexation,
- semantic web by combining automated and manual metadata, and
- ontology-enhanced search with domain-related information to optimize search results.

5. REFERENCES

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