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¹Shikshan – a Hybrid Framework to
Augment Instructional Video

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Abstract

This paper proposes a framework to augment offline instructional videos in order to create a comprehensive distance educational platform for use in developing countries. The assumptions underlying the framework are based upon ground realities in a country like India with inadequate educational and Internet infrastructure. However, television sets and cell phones are fast becoming ubiquitous. The framework is based primarily on such devices to provide educators as well as learners with a rich educational solution.

Keywords: developing countries, digital video, mobile learning, video library

Introduction

The video medium is being increasingly harnessed for its strong pedagogical potential at various levels. Quality improvement programs employ videos to mentor pre-service schoolteachers [1]. The merits of instructional videos in such areas as language teaching are undisputed [2]. MIT's Open Courseware Project showcases classroom videos of instructors along with other material – for free. Of late, distance education programs have begun to supplement text-based instruction with video segments. Even traditional students prefer a blend of asynchronous and face-to-face teaching styles to purely in-class lectures.

Digital video can facilitate distance learning in real-time or via asynchronous channels. The conventional infrastructure required to support real-time video is not practical in the context of developing countries. Videoconferencing is unaffordable for public schools. Television broadcasts of educational segments are effective only in areas with guaranteed power supply. In India, this is infeasible. It makes sense, therefore, to transfer complete control of the video playback to the end user. This is the principal benefit of asynchronous video, accessed via the Internet (streaming/download) or offline (VCD/DVD).

Three factors successively constrict the computer-based route to access video instruction on the Internet: poor PC penetration, insufficient Internet access and high bandwidth requirements. PC ownership in India is less than 6% [3] while dial-up Web access is stable only in urban areas. Bolstered by drastic price cuts in consumer electronics like television sets and compact disk players, videos on disk are now a viable option for distance education. Instructors can use these videos to enrich their classroom activities. Alternatively, they can serve as a capable mechanism of self-study for the learners.

Motivation

Offline videos are not a complete solution to the problems of education faced by the developing world. Their major drawback is the static nature of the contained instruction. In order to make them truly effective, it is essential for offline video based distance programs to offer some key services. Chief among these are efficient video search, summarizations, transcription and linguistic annotation, multi-language dubbing, multiple modes of feedback and support, remote tutor participation and learning assessment.

Cell phones have gained enormous reach in developing countries like India owing to several factors: progressive government policies, intense industry participation and reducing ownership costs. Notably, these devices can be used to access the Web. This paper illustrates *Shikshan*, a hybrid framework that combines the richness of digital video with the power of web services to create a versatile platform for distance education. Its implementation is the focus of a project coordinated by the author at his institution. A web site (<http://www.shikshan.net>) is dedicated to showcase its prototyping activities.

Methodology

Guidelines laid down by policy-making organizations for distance education form the foundation for the development of the *Shikshan* framework. The paper describes the various components of this framework. Next, the paper illustrates the set of services to be supported by any distance program that relies heavily on the use of offline videos.

Guidelines

In an extensive report [4], the American Federation of Teachers lays down best practices for distance education programs. Another report made by the Institute for Higher Education Policy [5] categorizes quality benchmarks for Internet education. Many directives such as supporting the participating faculty with financial incentives are uniformly applicable to all modes of distance education. Some guidelines, however, apply uniquely to programs that employ offline videos. They influence two main aspects - content and conduct - as illustrated by Table 1.

Aspect	Guideline benchmark	Adaptation to offline video
Content	Course design should be shaped to the potentials of the medium.	A mere transfer of lectures to the video format will result in under-utilization of the medium. Videos can include interviews, full-scale demonstrations, multimedia, etc.
Conduct	Course design is managed by teams comprised of faculty, content experts, instructional designers, technical experts and evaluation personnel.	A learning management system (LMS) to be provided, with multiple communication channels – email/discussion forums/chat/...
Content	Courses are designed with a consistent structure, easily discernible to students of varying learning styles.	The format of video instruction, which may vary depending on the subject, should be arrived at by extensive research and trials.
Conduct	Student interaction with faculty is facilitated through a variety of ways.	Students can interact with the faculty either face-to-face (as in the case of a classroom mediator) or via Web/wireless interfaces.
Content	Student interaction with other students is facilitated through a variety of ways.	Group exercises such as role-plays, debates, problem solving, etc. should be suggested by the videos. This will in turn motivate interested students to congregate and execute the suggested exercises.
Content	Each module requires students to engage themselves in analysis/synthesis and evaluation as part of their course assignments.	Each video segment must clearly set out its objectives. It should encourage reflective thought by posing exploratory questions. Quizzes can be conducted via the LMS.
Conduct	Easily accessible technical assistance is available to all students throughout the duration of the course/program.	Besides providing video tutorials on key technical areas, a mentor system will be in place to answer any other questions.
Conduct	Faculty members are assisted in the transition from classroom teaching to distance education and are assessed in the process.	Video production teams and instructional designers coach the faculty appropriately.
Content	Courses should cover all material.	Videos must cover both lecture as well as tutorial activities.
Conduct	The program's educational effectiveness is measured using several methods.	Periodic quizzes and surveys are conducted to provide the data for empirical analysis.

Table 1: Specialized guidelines for offline video

An open architecture shall be prescribed on *Shikshan* to permit maximum flexibility. Requirements shall be broadly stated for the components, for which multiple implementations may exist. Several factors govern the choice of implementation: availability of funds for the infrastructure, skill set of the support personnel, scale of the user population, means of access to the Internet (PC or cell phone), open or closed source, etc.

The complexity of tasks like linguistic annotation and video summarization makes them impossible to automate without making substantial compromises. Given the abundant availability of skilled manpower in developing countries like India, *Shikshan* will exploit the

potential of human inputs to infuse the desired level of quality into the final solution.

For the sake of convenience, no distinction shall be made between the framework and its implementation – both shall henceforth be addressed as *Shikshan*.

Framework

As depicted in Figure 1, *Shikshan* integrates several data repositories and information systems to build a robust platform to support distance education programs that rely on the use of offline videos.

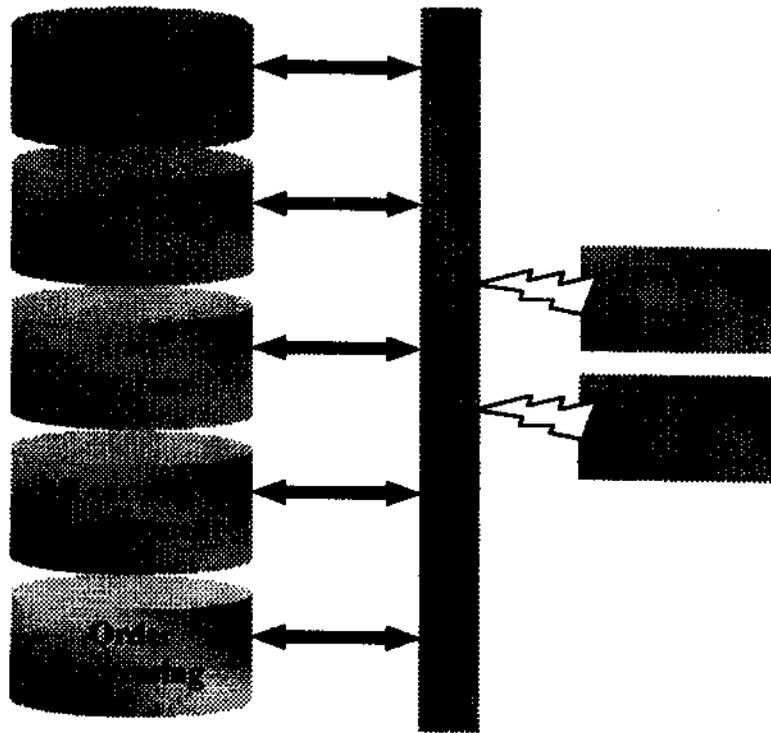


Figure 1: *Shikshan Framework*

The media library is a searchable repository of all the audiovisual content used by the distance program. Bolle *et al* [6] classify video inquiry into four stages viz. navigating, searching, browsing and viewing. While sophisticated queries are easy to conceive, the complex nature of the audiovisual medium warrants mechanisms for each stage that consult metadata about the content in order to make the process efficient. The practice of separating the metadata from the media helps intelligent agents to sift through the data based on prescribed filters and push the content to the interested user. The results of a search query can be bundled using the IEEE Learning Object Metadata model [7], and disambiguated at the client, which could be a Java-enabled cell phone or a full-fledged desktop computer.

The most basic metadata describing education audiovisual content is a direct speech transcription, obtained either with the help of voice recognition software or with human inputs. The MPEG-7 standard [8], whose principal objective is to describe various types of audiovisual material, offers a much more versatile option. Its Multimedia Description Scheme ably covers the requirements of the first two components in Figure 1. Many other standards for metadata compete with MPEG-7 [9] to describe audiovisual material.

Shikshan facilitates the synthesis of an XML-based schema to describe various educational events such as classroom interactions, interviews, lab demonstrations, tutorial exercises, etc. Conversation analysis [9] of the content will suggest a lexicon that can describe the

diverse interactions taking place within these events. Consequently, a meaningfully annotated full-length transcript can be constructed for each lecture segment using an XML schema that is based on this vocabulary. The role of humans in generating this transcription is indispensable, given the semantic complexity of the task.

Shikshan is specially designed to respond to the constraints of remotely located users by providing a powerful wireless interface. In essence, this mechanism frees the learner from having to own a desktop PC, a premium good in countries like India. The MPEG-21 standard [10] factors the usage environment into delivery considerations. The user database holds various categories of personalization information - role, profile, preferences, contact information, etc.

Quality of service (QoS) is an important criterion for information delivery. In particular, a cell-phone or handheld user must be able to solicit information about a video and receive a summary that combines keyframe stills with audio, while a more substantive motion video summary [11] should be delivered to a desktop user who can afford sufficient bandwidth and processing power. Incidentally, both mechanisms are alternate means to annotate the original video. Based upon a favorable viewing experience, the user may wish to watch the entire segment. An order management system fulfills this important role of *Shikshan* by offering a "shopping cart" to register user orders. Multiple segments can be impressed onto the same disk, thus allowing customization. Dispatching rich content using this channel

promotes a viable solution for distance education in developing countries.

With the prices of compact disks becoming negligible, motion video summaries of entire portions of the media library can be distributed in disk format to avoid Internet latency and download costs. For example, an eighth grader can benefit from browsing a catalogue of 2-minute summaries of all the relevant segments, compressed into one DVD. This is particularly useful for students who possess neither a wireless device nor a desktop. It is imperative to provide support for traditional postal services to enable students in the most backward areas.

A learning management system (LMS) shall facilitate standard distance educational activities such as online chat, forum discussion threads, email, document management, news announcements, quizzes, etc. The Open Knowledge Initiative [12] identifies basic features and services to be provided by an LMS. Several commercial and free implementations exist in the LMS marketplace. Moodle and dotLRN are examples of free, open source platforms. The requirement of wireless interactivity suggests various modes of augmentation of the services offered by standard LMS implementations. For instance, they should be able to record and display SMS messages, register voicemails, etc.

Finally, the "services layer" comprises the public interface to all of the above repositories and subsystems. It is described in full detail over the remaining part of the paper.

Services

The stakeholders of *Shikshan* fall into several categories: learners, instructors, transcribers, archival experts and system administrators. As a best practice, distance education programs must enable and encourage various types of stakeholder interactions as much as traditional modes of instruction. As discussed above, the implementation shall support two major access interfaces – Web and wireless – both of which have to facilitate stakeholder interactions to the maximum extent possible. In the context of developing countries, voluntary participation by quality instructors can substantially enhance the effectiveness and scale of distance education initiatives.

Teachers can choose to mediate offline videos in the classroom. Schools may in turn formally embrace distance programs that use videos. The viewers of these videos, mainly learners, may raise several queries. Some may wish to seek help from instructors across the Web. Threaded forums fulfill the social need for open discussions of diverse natures. Voice-mail mechanisms must also be supported so that students can simply state their questions verbally. Instructors must be able to browse from a common pool of questions and respond

based on their competencies. Their responses may be expressed in text or verbal formats. Based on the significance of the queries, FAQ databases must be populated to avoid redundancy.

The traditional services of an LMS such as content management, sustenance of user groups, drop boxes, chat rooms and assessment need no further elaboration. However, wireless alternatives must be furnished for some services, which may necessitate innovations like quizzes that accept verbal inputs.

Customized searches are a key feature of *Shikshan*. The system must be able to list question-answer pairs from the transcriptions that satisfy supplied keywords. If needed, the user must then be able to solicit the video segment that covered each interaction. Moreover, the learner should be able to place an order for precisely this bundle of information. It must be noted that content of any nature, either original or generated from discussion forums or question-answers, must be made available for personal use.

The transcription and annotation services for *Shikshan* should be carefully studied. Transcribers must have a simple Web interface using which they can embellish audiovisual content with semantic interpretations. Given the scope for human errors, feedback mechanisms must be in place to address them. VideoAnnEx from IBM provides an example implementation, where a lexicon can be dynamically loaded and content can be annotated.

Conclusion

Quality is a growing concern of distance programs today. Commercial interests can undermine the efficacy of the programs by purely focusing on profit and ignoring the quality angle [15]. Any distance educational program that employs offline videos should therefore consider the services it ought to offer in order to make it effective. This is undoubtedly a rich area of research with several difficult problems that are relatively easy to spot. Future activity on the *Shikshan* project will look into making the implementation scalable and cost-effective.

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About the Author

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¹ *Shikshan* is Sanskrit for education